RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL, AND AGRICULTURAL

DISCOVERIES:

BEING

An Abridgment

304

OF THE

PERIODICAL AND OTHER PUBLICATIONS,

ENGLISH AND FOREIGN,

RELATIVE TO

Arts, Chemistry, Manufactures, Agriculture, and Natural Philosophy;

ACCOMPANIED, OCCASIONALLY, WITH

REMARKS ON THE MERITS OR DEFECTS OF THE RESPECTIVE PAPERS;

AND, IN SOME CASES, SHEWING TO WHAT OTHER USEFUL PURPOSES INVENTIONS MAY BE DIRECTED, AND DISCOVERIES EXTENDED, BEYOND THE ORIGINAL VIEWS OF THEIR AUTHORS.

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PREFACE.

THE Proprietors of this Work feel great satisfaction in being able to offer to the public, in their fourth Volume, a collection of scientific and useful knowledge in no wise inferior in merit and importance to their former volumes, notwithstanding the troubled state of Europe has deprived them almost entirely of the materials for that portion of their work which they had hitherto received from the Continent. But though this part of their publication is much less extensive than usual, it is not totally devoid of interest. M. Laplace's paper on the theory of the tides, Dr. Sementini's on the incombustible man, and M. Dupont de Nemours on apparent death, are at least curious and worthy of particular notice. The advances made in this country towards the improvement of science have been more than usually important. The wonderful results of Mr. Davy's experiments are perhaps alone sufficient to compensate for the deficiency occasioned by the interruption of continental correspondence; and when the names of Dr. Thomas Young, Dr. Maskelyne, Dr. Herschell, and Professor Vince, are mentioned, as authors of papers noticed in this volume, nothing more need be said to enable the reader to appreciate its contents.

The Editors, however, cannot pass over in silence Dr. Parry's Essay on the Anglo-Merino breed of sheep: it is acknowledged to be the most complete treatise on the subject which has ever appeared; his account also of the cloth manufactured under his own immediate direction from wool the produce of this kingdom, has become uncommonly interesting from the excessive price to which cloth made from Spanish wool has recently been raised.

Though the circulation of this work is not so extensive as the Proprietors had just cause to expect from the talents engaged in it, yet they are happy in avowing that it has gradually increased; and they feel eminently proud in being enabled to say, that it enjoys the high distinction of being approved, both in plan and general execution, by some of the most exalted scientific characters in England, whose sanction must always be considered by the Proprietors as the most honourable reward they can receive; while they look forward with full confidence to the period when the interest and recommendation of such individuals, together with their own unremitting exertions, shall have procured for their work a circulation commensurate to their reasonable expectations.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL, CHEMICAL AND AGRICULTURAL DISCOVERIES.

No. XIII.] *January, February, March.* [1808.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

Improvements in Barometers, by M. PUGH.—*Gregory's Translation of Haüy's Philosophy, Vol. I.*

M. PUGH directs that, to remedy the inconveniences attendant upon the upright barometers, a graduated ruler should be applied parallel to the tube, having its lower end floating on the surface of the mercury in the cistern, according to the motion of which the scale will ascend or descend. Two or three supports, through which the ruler may pass so as to move freely, will be sufficient to keep it parallel to the column of mercury, whose length will be always visible; but for greater exactness, a moveable index, with a vernier, may be adapted to the scale, in such a manner, that one end shall be on a level with the surface of the mercury in the tube, while the vernier indicates the exact measure of the column.

Wheel-barometers may also be constructed to avoid most of the defects hitherto thought unavoidable in such instruments, thus: let a solid piece of glass, in the form of a pear, float upon the surface of the mercury in the tube: to the bottom of this ball let a piece of thread be attached, which may descend quite through the column of mercury, and pass round a pulley, placed under the orifice of the tube, from whence let it proceed to a second pulley, placed parallel to the former, in the cistern, and

afterwards over the pulley in the centre, which gives motion to the index: at the extremity of this thread must be fixed another small solid ball of glass, to give motion to the index when the mercury descends.

On account of the two pulleys, it will be necessary to make the cistern of such a size, that if the column of mercury should experience the whole extent of the variation, the height of the mercury in the cistern may suffer no visible change: thus, suppose that the diameter of the cistern is 4 inches, the total variation of the column will occasion a difference of $\frac{1}{24}$th part of an inch in the height of the mercury in the cistern, which is equivalent to an angle of 5 degrees formed by the index; but if the diameter of the cistern be 6 inches instead of 4, the difference will not exceed $\frac{1}{48}$th of an inch, corresponding to an angle of $2\frac{1}{2}$ degrees.

Observations.—We are pleased to insert in our Retrospect these hints for the farther simplification of such very useful and amusing instruments as barometers. When a mathematician and philosopher of so much eminence as Mr. Gough (see Retrospect, vol. ii. pa. 4) takes an interest in such simplifications (Retrospect, vol. iii. pa. 475), and himself proposes one of no small value and ingenuity, we need not apologize for thus making our work the receptacle of other important suggestions, tending to the accomplishment of the same object.

Micrometer for measuring Distances, &c. by David Brewster, *A. M.—Gregory's Translation of Haüy's Philosophy, Vol. II.*

Mr. (now Dr.) Brewster, who has lately directed much of his attention to the improvement of micrometers (Retrospect, vol. iii. pa. 539), has recently invented one, in which a pair of fixed wires is made to subtend different angles by varying the magnifying power of the telescope, by sliding one tube within another; whereas, in all other micrometers with wires, this effect is produced by mechanical contrivances. Dr. Brewster's method of shutting and opening the wires optically is therefore free from all those sources of error to which other micrometers are subject; while the mode of changing the magnifying power by the motion of a second object-glass affords a length of scale equal to the focal distance of the principal object-glass.

In the common micrometer, which can manifestly, as well as Mr. Cavallo's and Dr. Brewster's, be used in the mensuration of distances, the focal length of the telescope, to which it is attached, remains always the same; so that a correction computed from an optical theorem must be applied to every angle that is measured; but in Dr. B.'s telescope and micrometer, the focal length varies

in the same proportion as the distance of the object; and consequently no correction of the angles can be necessary. To obviate the necessity of having a stand for the instrument, which would prevent its usefulness at sea, Dr. B. divides the second or moveable object-glass into two, as in the divided object-glass micrometer. By this contrivance two images are formed, and these images are separated and made to form different angles at the eye, by bringing the moveable object-glass nearer to the fixed one. In determining the angle, therefore, it is only necessary to bring the two images of the object into contact; and such contact the eye is capable of ascertaining, even during the agitation of a carriage, as the two images retain the same relative position, whatever be their absolute motion.

Observations.—We hope Dr. Brewster will appoint some London artist to make and sell this ingenious instrument, which, being formed with sliding tubes, is extremely portable and convenient. It will be found highly useful to practical astronomers, as well as to military gentlemen and others, who may wish to ascertain distances without a more cumbersome apparatus.

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1. *On the Stanhope and other Temperaments of the Musical Scale. By Mr.* John Farey.—*Phil. Mag. No.* 116.
2. *On the two Systems of Musical Temperament recommended by Earl Stanhope, Mr. Hawkes's System, &c. By Mr.* John Farey.—*Phil. Mag. No.* 117.
3. *Letter from Earl* Stanhope *relative to Dr. Calcott's Pamphlet on the Stanhope Temperament.*—*Phil. Mag. No.* 117.

I. The first of these communications from Mr. Farey gives a correction of *three* errors in the table of musical intervals, engraven for the 112th number of the Philosophical Magazine; then enters into a relation of some circumstances relative to the publication and suppression of pamphlets, by Dr. Calcott, on the Stanhope temperament; and then presents a table for the comparison of the intervals in the isotonic system, M. Prinz's system, and M. Kirnberger's, by means of Σ, f, and m, or *schismas*, *lesser fractions*, and *most minutes*.

II. Mr. Farey's second communication exhibits a table, shewing the relations which the several notes in an octave, above the tenor cliff C, bear to the key note, when tuned according to the *equal-beating* system of Earl Stanhope; with the notes of Mr. Hawkes's system, for comparison. Several remarks are added to illustrate the nature and use of this table; we transcribe the following, as the most general and important:

"I beg here to mention, respecting the new notation for musical intervals, that the octave happening to contain just 12 of the

lesser fractions f, and one of these to fall near each note of the equal temperament; in almost all calculations respecting *Douzeaves*, the temperaments or results, are free of f, and *two* only of the *three* independent or *prime* terms, of which every *accurate* notation must consist, are in general found at last; while the smallness of the *most minute* m, it being less than the $\frac{1}{127}$th part of the *schisma* Σ, which is itself but a very trifle more than $\frac{1}{11}$th part of a comma, c, (or $\frac{1}{11}\Sigma + \frac{1}{11}$m) renders it allowable in most practical cases to neglect m, and to consider the Σ s as *elevenths* of a comma, in the results; although I would advise the previous calculations to be always carried on strictly in Σ, f, and m, especially as the number of f s will generally point out to what finger-key, or number of half-notes, any step in the process answers."

III. Earl Stanhope commences his letter by correcting the inaccuracy in Mr. Farey's statements, relative to Dr. Calcott's pamphlets: he then proceeds thus:

"As Mr. Farey has obliged me, much against my wish, to take up my pen again on his account; I must freely confess I can perceive no merit in his calculations.

"I have expressed the length of the wire which yields the sound of the *perfect quint* G, in the correct, precise, and plain language of *two thirds* of the length of the wire, which yields the sound of the key-note C. This does not, however, satisfy Mr. Farey. He is not contented till he has told us, that *two thirds* may be expressed by ·6666666 *ad infinitum*.

"He is not even content with this; for he introduces, moreover, what he terms a '*new notation*;' and he expresses '*the* '*relation which the note* G *bears to the fundamental note* C, *ac*-'*cording to the Stanhope temperament*,' as follows, namely,

by 358 Σ (or *schismas*).
\+ 7 f (or *lesser fractions*).
\+ 31 m (or *the most minute*).

"This he no doubt considers as greatly advancing the cause of science, and as rendering the study of music both more pleasant and intelligible!!!

"What would any man think of a mathematician who should express the number 8691 in the following manner?

8000
\+ 600
\+ 3 score
\+ 2 dozen
\+ 7.

"The difference between a man of *real* science, and one who has the ambition to be thought so, is very great. The first seeks to render difficult subjects perspicuous and clear; the other, on the contrary, envelopes even the most simple ideas in the mysterious garb of *hard words* and *scientific jargon*. If Mr. Farey be of the first of those two classes, I should recommend to him to simplify and amend his tables."

Observations.—We are sorry that a discussion, from which, at the outset, we expected to derive so much pleasure and instruction, should have now become so barren and unprofitable as this on musical temperament. The subject, in judicious hands, would be found fertile in the most curious and delightful results; but these will neither be elicited by mutual recriminations, nor rendered obvious when presented in the garb of an obscure and forced notation. Had Svanberg, and the other Swedish mathematicians, given the results of their recent measurement of a degree in Lapland, in terms of the *cubit*, or of *the measuring rod of Ezekiel*, instead of the thanks of the philosophical world, they would have received its ridicule: and, unless our present writers upon musical temperament will be inclined to retrace their steps, and take a lesson from the judicious remarks of Earl Stanhope, just quoted, they will neither throw any new light upon an intricate topic, nor enhance their own reputation, by their investigations, however patiently and laboriously they may have been conducted.

Directions for constructing a cheap Bed and elastic Frame, for the easy Conveyance of sick or wounded Persons. Invented by Patrick Crichton, *Lieutenant-colonel of the Second Regiment Royal Edinburgh Volunteers.—Phil. Mag. No.* 116.

The principal parts of this apparatus, besides the bed and cot, are two rectangular frames, which are to be posited parallel to each other, and to the horizon. The lower frame may be made of ash or elm, being 7 feet long, and 5 feet 4 inches broad: it should have 4 handles projecting from it in the same plane, each about 15 inches long, by means of which the whole may, when necessary, be carried by 4 men. From the middle of the sides of this frame, rise two strong vertical wooden pillars, about $2\frac{1}{2}$ or 3 feet long, and bound on the sides by two semicircular pieces of iron. Upon these pillars and pieces of iron are supported the upper frame, which is elastic: it should be made of ash, remarkably clean and well seasoned, thick in the middle, where it is supported, and tapering gradually towards the ends. At each of these ends there are two hooks. The frame or cot may be constructed nearly in the usual way, and contain a mattress or pelisse, stuffed with straw, or other suitable substance. From the head and foot of the cot, proceed 4 cords and rings, by means of which the cot may be suspended from the hooks at the end of the elastic frame; and, in consequence of such suspension, the motion of the bed will be rendered comparatively easy, even though the lower frame should be laid upon the top of a jolting carriage. The upper frame carries 4 semicircular hoops, at equal distances, over which a cover can be thrown, to protect the patient from the weather. The total expense of the whole, including the iron-work, need not exceed 4 pounds 10 shillings.

Directions for using the Bed and Frame. The lower frame may be fastened by ropes to any cart or waggon, of the same size, or larger than itself. The sick or wounded person should first be placed in the bed. The frame should then be placed over the bed, and the ropes at the head of the bed suspended upon the iron hooks. Then the ropes at the feet should be hooked up. The frame, containing one or two sick men, can be easily lifted by the four handles, by four men, and carried to any distance, to a cart or baggage-waggon. The lower frame is then fixed to the cart by ropes, and the machine is ready to move. When the sick are taken from the baggage-cart, the whole apparatus should be lifted *at once*, and carried to the hospital. The bed should then be unhooked, first at the feet and then at the head, and the two frames taken away.

From the instances of the successful application of this apparatus, we select the following: a person was brought in it, with a compound fracture in the thigh-bone, from the west Highlands to Edinburgh, a distance of 74 miles, in two days. A gentleman, with an attack of the gout, both in his hands and feet, was removed from Edinburgh to the north of England, above 140 miles, in 3 days. In both instances the bed and frame were suspended to the carriage of a post-chaise, and, with a servant sitting in front, travelled post. The patients, in all the removals, bore testimony to their enduring no additional pain or inconvenience from the motion of the machine.

Observations.—It is needless to expatiate on the utility of a contrivance like this: it must at once strike every mind. The advantages derivable from this simple apparatus in the conveyance of sick and wounded soldiers from distant quarters or garrison to a general hospital; or in transporting any person taken ill, or meeting with an accident, from home, to his usual residence, cannot but be very great. We sincerely hope it will be universally adopted in our army; and present Col. Crichton with the willing tribute of our praise for his ingenuity and his laudable desire to give publicity to his invention.

Project for the Establishment of Telegraphs on a new Construction. By Captain Pasley, *of the Royal Engineers.—Phil. Mag. Nos.* 115, 116.

Captain Pasley has invented two telegraphs, one of which is intended for the transmission of signals by night, the other by day.

1st. *A nocturnal telegraph.* The proposed telegraph consists of six fixed lights, disposed in two rows of three lights each, one row placed exactly over the other. These are supposed to be kept constantly burning whilst the telegraph is worked; and being hid

or shewn at pleasure by means of blinds, they form 41 distinct combinations or signals; the combinations of six bodies, which should properly be 63, being reduced to this number by the ambiguity arising from its being impossible to ascertain the relative places of objects by night as we can by day. The construction of the telegraph will be understood by conceiving six large lanterns attached to a strong frame of timber, placed in the upper room, or on the roof or terrace of a building; in which latter case it may be protected by a shed from the injuries of the weather. Each of these lanterns will contain a lamp, the intenseness of whose light must be proportioned to the distance between the telegraphic stations, upon which the distance of the several lanterns on the frame from each other will also depend. Every lantern must have two blinds, one on each side of it; to which are fastened strings passing through the ceiling of the signal-room, and guided by pulleys to a convenient place below, where they can be worked by a single man. The blinds are so hung, that in their natural state, when the telegraph is at rest, all the lights are hid except the middle one of the lower row, which serves to guide the eye of the observers; and is therefore called the standing light, being always exhibited during the intervals between successive signals.

In the table of combinations, or key of the telegraph, after leaving *one* for the standing light, and assigning 30 combinations to denote the letters of the alphabet, numerical cyphers, &c. the remaining 10 places are left blank. It is needless to explain the use of the first 30 signals, which are capable of communicating every kind of intelligence alphabetically, in a manner that is perfectly obvious. But with regard to forming a code of signals, the method proposed is this:—Let any number of words and sentences, that are most likely to occur in practice, be written in regular order, to the extent judged necessary, and if these do not exceed 300, let them be divided into sections according to a method shewn in the following table.

Number of Sections made use of.	Number of Places in each Section.	Total Number of Words and Sentences forming the Code of Signals.
1	39	39
2	38	76
3	37	111
4	36	144
5	35	175
6	34	204
7	33	231
8	32	256
9	31	279
10	30	300

Then let the blanks denote that "*The ensuing signal will be read in the first section*;"—let a second blank denote, that "*The ensuing signal will be read in the second section*," and so on; and thus may any list of words and sentences under 300 be represented by two changes on the telegraph, exclusive of all unusual or extraordinary intelligence, which may be communicated alphabetically by the ordinary key.

But when the number of words and sentences required exceeds 300, the signal-book must be divided into two parts, the first of which will contain a certain number of sections, composed of 30 places each, whilst the second will contain a number of sections, consisting of 900 places each; observing only that the number of sections in both parts added together must not exceed ten: then, instead of filling up the blanks in the manner before proposed, a certain number of them must denote, that "*The ensuing signal must be read in* such *a section of part first*," whilst the remaining blanks will signify, that "*The two ensuing signals must be read in* such *a section of part second*, specifying the particular sections of each; and according to the manner in which the two parts are divided, will be had a code of signals more or less extensive: as indeed is shewn by the tables, &c. given by Captain Pasley; from which it appears that if the method used in the second part be carried to its utmost extent, a signal-book may be formed, containing 9000 words and sentences, that may be represented by three changes on the telegraph, retaining still the power of using the alphabetical mode when necessary. And, in fact, the number is capable of indefinite augmentation, by means of the same principle.

2d. *A polygrammatic telegraph for day signals.* This instrument is capable of exhibiting 707,280 distinct combinations: its nature and construction being as follows:—Four upright posts are erected, each having two arms moveable on a spindle at top, which, in their natural position, hang down, but can be raised by means of strings to various degrees of extension, so as to appear in positions either vertical, horizontal, or inclined at an angle of 45° with the horizon. The length of the arms may be about 6 feet from the centre of motion to the ends, or more, in proportion to the distance between the telegraphic stations. The strings should be worked by two men.

The combinations of two arms in the several positions enumerated (and shewn in a plate in the Philosophical Magazine) are 28; eighteen of these are allotted to the alphabetical characters, and 10 to the numerical ciphers, so that using the common mode of signal-making, every post with its arms might form a complete telegraph, were it not the object of the present proposal to go farther. A book is therefore made of words and sentences arranged in regular order, to the extent judged necessary; and let signal 2567 signify, for example, "*The enemy have landed upon the south-west coast*;" while signal 9304 signifies, "*A convoy is*

just arrived from the West Indies:" then these two pieces of intelligence will be successively communicated by two simple signals.

But this telegraph has another property, namely, that of expressing words or parts of words not exceeding four letters, by a single signal: and this property enables the operator to transmit sentences comprising 6 or 7 words, by about as many signals.

In working this telegraph, no signal is required to denote the end of a word, it being sufficient to mark a pause by leaving one of the posts in its quiescent state. And to distinguish between the numerical signals referring to the book or code, and such as are really intended to denote numbers, the unit's place of the latter must *never*, but that of the former must *always*, be placed on the fourth, or right-hand post of the telegraph. Hence this post, when left quiescent between two numbers, will not be considered to denote a pause or break, as it would between two words. Observing this restriction, it will be found that a signal-book may be formed, containing 10,999 words and sentences, if thought necessary, each to be expressed by one change on this telegraph, whilst all unforeseen intelligence can be communicated by an improved alphabetical mode; without these two methods interfering in the least with each other.

Observations.—These telegraphs are both ingenious, and are especially deserving of notice, because they facilitate the transference of information, by both the methods usually adopted when telegraphs are employed, viz. by using a distinct signal for each letter, and by causing every individual signal to represent a complete sentence. In the estimation of many persons the latter method has the advantage in point of expedition; but, for our own parts, we doubt the truth of this opinion, generally speaking. Supposing there were a table, containing 10,000 of the sentences most likely to occur; let it be considered that it would be a very considerable exercise for the memory to call to mind in an instant the appropriate numerical expression for each phrase; and unless this can be done with tolerable facility, nothing is gained in point of expedition, by the circumstance of a single phrase being denoted by its appropriate signal. Besides, it is not only within the range of possibility, but *very probable*, that a phrase may occur to be communicated, which is not in the table, supposing it to extend to 10,000, or even more. In such emergencies, the utility of a mode of conveyance, in which the information shall be transmitted letter by letter, is obvious; and in such emergencies it is that Captain Pasley's telegraphs will be found to merit a decided preference over those which convey particulars by phrases only. Still, however, it is our opinion that those who direct their attention to the improvement of telegraphs, would do wisely to confine it principally to the *alphabetic* mode of transmission; that being manifestly the only universal mode. And we are convinced that it would be no difficult task to point out a method by which

news should be transferred letter by letter, not much slower than it could be written; a degree of comparative celerity which it can be not at all necessary should be exceeded by telegraphic communication.

Some Observations on Dr. Taylor's Theorem for the Developement of the Function $\varphi\,(a + x)$. *By* W. S.—*Phil. Mag. No.* 115.

When the *Methodus Incrementorum* of Brooke Taylor was first published, some of the continental analysts seemed to think that the theorem $\varphi\,(a + x) = \varphi\,(a) + \frac{x}{1} \cdot \frac{\mathrm{d}\,\varphi\,(a)}{\mathrm{d}\,a} + \frac{x^2}{1.2} \cdot \frac{\mathrm{d}^2\,\varphi\,(a)}{\mathrm{d}\,a^2} +$ &c. which he had given as a discovery of his own, was really the same with another theorem, which John Bernoulli had previously investigated, and by which he had been led to the value of $\int y\,\mathrm{d}\,x$, when y is a function of x alone. But it is now universally admitted, that the two theorems are totally different in the objects and purposes to which they may be applied. The present author, however, explains a method by which the one may be deduced from the other.

If we take the successive differentials of Taylor's theorem (as above expressed), according to a, we shall obtain a series of new equations, by means of which we can easily eliminate all the terms on the right-hand side, except the first, and the result will be $\varphi\,(a) = \varphi\,(a + x) - \frac{x}{1} \cdot \frac{\mathrm{d}\,\varphi\,(a+x)}{\mathrm{d}\,x} + \frac{x^2}{1.2} \cdot \frac{\mathrm{d}^2\,\varphi\,(a+x)}{\mathrm{d}\,x^2} +$ &c.: or, by transferring the terms to the other side, we shall have $\varphi\,(a + x) = \varphi\,(a) + \frac{x}{1} \cdot \frac{\mathrm{d}\,\varphi\,(a+x)}{\mathrm{d}\,x} - \frac{x^2}{1.2} \cdot \frac{\mathrm{d}^2\,\varphi\,(a+x)}{\mathrm{d}\,x^2}$ &c.

In this form of the developement if we take $a = o$, then will $\varphi\,(x) = \varphi\,(o) + \frac{x}{1} \cdot \frac{\mathrm{d}\,\varphi\,(x)}{\mathrm{d}\,x} - \frac{x^2}{1.2} \cdot \frac{\mathrm{d}^2\,\varphi\,(x)}{\mathrm{d}\,x} + \frac{x^3}{1.2.3} \cdot \frac{\mathrm{d}^3\,\varphi\,(x)}{\mathrm{d}\,x^2}$ +, &c.: and if $\varphi\,(x)$ represent the area of a curve of which x and y are the co-ordinates, then $\varphi\,(x) = \int y\,\mathrm{d}\,x$; $\frac{\mathrm{d}\,\varphi\,(x)}{\mathrm{d}\,x} = y$; $\frac{\mathrm{d}^2\,\varphi\,(x)}{\mathrm{d}\,x^2} = \frac{\mathrm{d}\,y}{\mathrm{d}\,x}$, &c.; and $\int y\,\mathrm{d}\,x = \varphi\,(o) + x\,y - \frac{x^2}{1.2} \cdot \frac{\mathrm{d}\,y}{\mathrm{d}\,x} + \frac{x^3}{1.2.3} \cdot \frac{\mathrm{d}^2\,y}{\mathrm{d}\,x^2} -$, &c.; where the quantity $\varphi\,(o)$ represents the constant one, requisite for completing the integral.

The binomial expression $(a + x)^n$ is then submitted to this species of developement; and a valuable convergent series is obtained for a useful form of it, namely, $(a + 1)^n = a^n \left(1 + \frac{n}{a+1} +\right.$

$\frac{n.\ (n+1)}{1.2\ (a+1)^2} + \frac{n.\ (n+1)\ (n+2)}{1.2.3\ (a+1)^3} +$, &c.$\Big)$ where the series is always more convergent, as a is the larger.

Lastly, the theorem is applied to the determination of the sine and cosine of $a + x$; but as there is nothing which has the semblance of novelty in this part of the paper, we need not go farther into detail.

Observations.—We are much gratified to see a theorem so fertile in important consequences as this of Brooke Taylor's, beginning to attract the notice of English mathematicians: we say, *beginning* to attract the notice; for it is not a little extraordinary, that, while every foreign mathematical author of reputation, for nearly a century, has displayed the uses of this admirable theorem, we are persuaded there are not *twenty* mathematicians now living in the country where it was first invented, who ever heard or read of it. The case is nearly the same with some of the most important discoveries of another of our eminent mathematicians, *Thomas Simpson*: his elementary books are in the hands of all our philomaths; whilst his most valuable productions lie mouldering upon the bookseller's shelves, and are never mentioned, except by continental mathematicians. These are phenomena which evince a sad deterioration of mathematical science amongst us; and as this is a circumstance which calls loudly for attention, since the most exalted discoveries can only be expected where theory and practice go hand in hand, and where the latter is not led to distinction by the abandonment of the former, we trust we shall be thought in the line of our duty by marking the fact in this place. We would also recommend to general notice, some excellent observations, connected with this subject, in the 22d No. of a contemporary periodical performance, the *Edinburgh Review*, towards the end of the critique upon *Laplace's Celestial Mechanics*.

With regard to Dr. Taylor's theorem, such of our readers as are not conversant in foreign mathematics, will comprehend it better if we state it thus: If x and z be two variable quantities, the relation of which is given, then while x, by flowing uniformly, is increased by $\dot{x}$, z will be increased by $\dot{z} + \frac{\ddot{z}}{1.2} + \frac{\dddot{z}}{1.2.3} +$, &c.; where the values of $\dot{z}$, $\ddot{z}$, &c. are to be determined from the given equation. In this form the theorem is demonstrated by Mr. Brinkley, in vol. vi. of the Transactions of the Irish Academy. Another demonstration is given by Lacroix, at pa. 25, of his *Traité Elementaire de Calcul Differentiel*. These, and an excellent synthetical demonstration, by the learned Frisi, are all we now recollect.

Taylor's theorem may, indeed, be expressed more generally still: for, if z be a quantity, composed of two or more inde-

pendent quantities, x, y, v, &c.; then while x, y, v, &c. by flowing uniformly become $x + \dot{x}$, $y + \dot{y}$, $v + \dot{v}$, &c. z will become

$$\dot{z} + \frac{\ddot{z}}{1 \cdot 2} + \text{ &c.}$$

Farther, the very able Swedish mathematician Swanberg has given greater generality to the theorem, and in determining the series which serves to calculate the value of an elliptic arc from that of the angle intercepted between the perpendiculars drawn at the extreme points of that arc (*Exposition des Operations faites in Lapponie*, sect. 4), he applies the extension given to the theorem in the Memoirs of the Stockholm Academy, where the developement of functions in series, arranged according to the powers of some quantities, may be obtained with respect to the sines and cosines of the multiples of those variables.

It is far from improbable that other generalizations may yet be thought of; and those such as may be productive of useful applications: but we have said enough, we trust, to direct the attention of many English mathematicians to this curious theorem.

Description of the Mountain Barometer, invented by Sir Henry C. Englefield, *Bart. F. R. S. and made by Mr.* Thomas Jones, *of Mount Street, Berkley Square.—Phil. Mag. No.* 117.

This is a republication of a paper which appeared nearly two years ago, in No. 55 of Nicholson's Journal, with a few alterations and improvements. In our account of that paper (see Retrospect, No. 5; or vol. ii. p. 148) we described Sir H. C. Englefield's barometer: it now remains for us merely to add this gentleman's rules for the determination of altitudes, independent of logarithms.

To this end, Sir Henry has caused the following short table to be engraven on the scale of the barometer. It expresses the value of the difference of the tenth of an inch in the height of the mercury, at the temperature of freezing, in English feet.

Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.
20·05	130	22·25	117	25·05	104	28·35	92
·20	129	·45	116	·30	103	·65	91
·35	128	·65	115	·55	102	·95	90
·50	127	·85	114	·80	101	29·27	89
·66	126	23·05	113	26·05	100	·61	88
·82	125	·25	112	·30	99	·95	87
21·00	124	·45	111	·57	98	30·30	86
·18	123	·65	110	·85	97	·65	85
·35	122	·87	109	27·15	96	31·00	84
·53	121	24·10	108	·45	95	·37	83
·70	120	·32	107	·75	94	·75	82
·87	119	·55	106	28·05	93	32·10	81
22·05	118	·80	105				

The method of using it is as follows:—1st, Add the two observed heights of the barometer, and halve the sum to obtain the mean height. 2d, Subtract the less height from the greater, the remainder is of course the difference of height in tenths, &c. of an inch. 3d, Enter the table with the mean height, and take out the feet answering to it, making a proportion, if the mean height does not exactly answer to a foot. (This proportion may be made by head.) Multiply the number thus obtained by the tenths, &c. of an inch of difference of height. The result will be nearly the number of feet, answering to the difference of height between the two barometers at the temperature of freezing. When the lower barometer stands between 29 and 30 inches, and the elevation does not exceed 1500 feet, this rule will give the height within one foot of the result from the logarithmic method. When the elevation is about 3000 feet, the error will be nearly 3 feet; and when the height is greater than 3000 feet, the error increases in a higher ratio. It is always in defect. In this country, however, such elevations do not exist; and in those parts where a knowledge of the comparative heights of the different hills is the most generally useful, they seldom exceed 1000 feet; at all events, such observations as relate to great elevations may be always recomputed by more rigorous methods at leisure.

The correction of the heights thus obtained, for the temperature of the air above freezing, is by Sir George Shuckburgh supposed to be as the height of the thermometer, and to be 2·44 thousandths of the approximate height for each degree of Fahrenheit, additive when the temperature is above freezing, and substractive when below freezing. General Roy's observations and experiments lead to a supposition that the correction is not exactly as the height of the thermometer, and that, at about the temperature of 50 degrees, it amounts to 2·5 thousandths, and is less, both much above and much below that temperature. For the purpose of immediate computation, take the correction at 2·5, which, though certainly rather too great, will, in general, be productive of very small error, and affords a rule which is easily remembered and quickly applied. It is this:

For every four degrees that the mean temperature of the two detached thermometers exceeds 32 degrees, add one hundredth of the approximate height, as before obtained, to it; for every 40 degrees one tenth, and so for any greater or less number of degrees.

The correction, which in fact ought to be the first in order, is that for the difference of temperature of the two barometers themselves: but this correction is, in general, so small, as to be safely neglected. Should it, however, be thought necessary to apply it in this approximate method of computing heights, the rule deduced from Sir George Shuckburgh's method is as follows, and it wants no table, though he has given one for it.

When the barometer stands at 20 inches, the expansion of the mercury for one degree of Fahrenheit is two-thousandths of an inch; when it stands at 30 inches, it is three-thousandths; and, for the intermediate inches, it increases exactly as the height of the mercury; that is, at 21 inches it is ·0021; at 22 inches, ·0022, and so on: so that the height in inches is the number of ten-thousandths of expansion for one degree of Fahrenheit. The rule, in short, is this: take the difference of the height of the *attached thermometer* at the two stations, and multiply the expansion for one degree at the coldest barometer (which will almost always be the one at the highest station) by the number of degrees of difference between the heat of the two barometers, and add the quantity to the observed height of the coldest barometer, and it is corrected for the expansion of the mercury by the heat of the instrument.

Observations.—We may add here, that the weight of this improved barometer is less than a pound and a half, while that of Ramsden's last improved barometer is $4\frac{1}{2}$ pounds. We wish every success to this ingenious contrivance, and are far from imputing any improper motive to the learned and worthy Baronet for republishing his paper with improvements, after an interval of two years:—but we must confess it struck us very oddly to see a paper of Sir H. C. Englefield's introduced to public notice by Mr. Thomas Jones, of Mount Street, Berkley Square, in which very paper the said Mr. Thomas Jones is recommended by the said Baronet as the maker of his mountain barometers: this looks sadly like the *puff direct*, and the *puff reverse*; but, as we unfortunately are now to judge for the public, we cannot offer either of them the *puff oblique*. Mr. Thomas Jones is, we are convinced, a very ingenious artist in the line of his profession; and we conjecture he is not altogether ignorant of philosophy: but we doubt not that his merit will, in proper time, find its due encouragement, without his again having recourse to the method of describing himself in the Philosophical Magazine as the *maker* of the instruments invented by other celebrated men. These might form fit advertisements for the wrappers of the Philosophical Magazine, and similar publications; but we cannot silently suffer science to be degraded by the introduction of any such artifices into the body of a scientific work.

Letter from Gavin Lowe, *Esq. on the Comet of* 1807.—*Phil. Mag. No.* 117.

Mr. Lowe had opportunities of observing the comet, which first made its appearance towards the end of last September, 14 times between the 4th of October and the 12th of November: from the data deduced from those observations, he computed the ele-

ments according to the rules laid down in Sir Henry Englefield's excellent Treatise upon Comets. His principal results are these:

Perihelion distance 0·64802, the mean distance of the earth from the sun being denoted by unity.

Longitude of perihelion - - -	28° 41′ in Scorpio.
Longitude of ascending node - -	26 36 in Sagittarius.
Time of passing the perihelion - -	Sept. 18^{d}. 22^{h}. 10^{m}.
Do. do. ascending node - - -	Sept. 29^{d}. 18^{h}. 48^{m}.
Heliocentric longitude of line of apsides -	13° 11′ Gémini.
Northern latitude of do. - - -	24° 43′
Inclination of the orbit to the plane of the ecliptic	63° 75′

These elements are accompanied by a diagram representing the comet's orbit, simply applied to, but not projected upon, the plane of the ecliptic.

Observations.—The principal elements of the cometary orbit, as determined by Mr. Lowe, agree nearly with those given by other astronomers, except in *one* particular; namely, the distance of the line of the apsides from that of the nodes. According to Mr. Lowe's computation, this distance is nearly 28 degrees: whereas, in some elements which were computed by Sir H. Englefield, and the Hon. Henry Cavendish, from some early observations of the Astronomer Royal, the distance of the place of the comet's perihelion was less than *one degree* from that of the ascending node. This is a remarkable peculiarity, in consequence of which nearly one half of the comet's orbit would be above the ecliptic, and the other half below it. We hope some future, though not delayed, publication of elements, from the longest and most favourable series of observations, will shew *decisively* whether this peculiarity did or did not obtain.—The telescopic appearance of this comet was very singular: and we believe this celestial visitant was in many respects different from any that has yet been observed. We look forward anxiously to some more mature communication with regard to it.

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1. *On the Means of gaining Power in Mechanics. By* E. V.—*Phil. Mag. No.* 116.
2. *A second Letter from* E. V. *on the Means of gaining Power in Mechanics.—Phil. Mag. No.* 117.
3. *On* E. V.*'s Article "On the Means of gaining Power in Mechanics." By* T. Swanwick.—*Phil. Mag. No.* 117.

I. Mr. E. V. either has constructed, or thinks he has constructed, an instrument, rather simple than complicate, which produces the following effect: "On applying his moving power, a weight *of two pounds*; while this descends through a *space of only 3 feet, a weight of 20 pounds is thereby raised 2 feet perpendicularly.*" The same moving power also raises another *considerable weight to a small height,* at and in the same time. This is

Mr. E. V.'s novelty, the possibility of which cannot, as he says, "be admitted consistently with the present theory of mechanics."

II. In his second communication, this writer affirms, that his engine has been so improved, that, with the same moving power, the same velocity, &c. it raises a weight of 30lbs. instead of 20: and he says, there is reason to believe it may yet be made far more powerful. But more of this, he assures us, shall be the subject of his next paper.

III. Mr. Swanwick remarks, that, as E. V. has neither given a description nor a drawing of his machine, it is impossible to give any other opinion of it than a general one, and that must be against it. He observes, that mechanical contrivances may all be reduced to the effect of a lever, or of a combination of levers; and though he seems to hesitate a little as to E. V.'s machine, he can with safety affirm, that the lever possesses no such power as is attributed to this new machine.

He does not, however, attempt to deny what E. V. so positively asserts; but this he asserts with equal confidence, that, though his machine may perform as above related, it is impossible that it should continue to do so; it must, sooner or later, come to rest, and will then require as much external power to restore the machine to its former state of rotatory motion, as it had apparently gained power beyond the laws of mechanics by its first effort.

Observations.—We are of opinion, that the editor of the Philosophical Magazine should not have given insertion to any of E. V.'s communications, unless he had sent explicit descriptions of the nature and manner of operation of his machines. When once a clear account of either instrument is published, we shall not find much difficulty in detecting the fallacy which seems to have deluded its author: we say, *seems* to have; for we are under apprehensions that E. V. is some wicked wag, who, knowing the paucity of theoretical knowledge among most of our practical mechanics, is disposed to enjoy a laugh at their expense. But we warn him off such dangerous premisses: he has not wisdom enough to be a successful wit, and may therefore run himself into some awkward rencontre when he only means to be cracking a joke.

Mr. Swanwick, who has taken up the cudgels against this man of straw, falls into a very common mistake, when he says that the mechanical powers may be all reduced to a lever, or to a combination of levers. Thus, as Dr. Hamilton and others have long ago remarked, the pulley (for example) cannot properly be considered as a lever of any kind; for when any power sustains a weight by means of a system of pullies, that power will sustain the same weight if the pullies be removed, and the ropes be brought over the axles on which the pullies turned. If the weight were to be

raised, there would, it is true, be a very great resistance from the friction of the ropes on the axles; and it is merely to avoid this resistance that fixed pullies are used, because they move round the axles with but little friction.

Experiments for investigating the Cause of the coloured concentric Rings, discovered by Sir Isaac Newton, between two Object-glasses laid upon one another. *By* WILLIAM HERSCHEL, *LL.D.* —*Phil. Trans.* 1807, *Part II.*

NEWTON explains the appearance of the coloured arcs, or rings, which he discovered by laying two prisms or object-glasses upon each other, by ascribing to the rays of light certain fits of easy reflection, and easy transmission, alternately returning and taking place with each ray at stated intervals. This hypothesis, however, not to mention other objections, does not seem to be reconciled with ease to the minuteness and extreme velocity ascribed by Newton himself to the particles of light.

A series of experiments was therefore begun, and the conclusions drawn from them seem to point out several *modifications* of light that have been totally overlooked, and others that have never been properly discriminated. By modification is here meant all the changes that are made in the colours, direction, or motion of light; thus by the modification of reflection light is flung back, by that of refraction it is bent from its former course, and by that of dispersion it is divided into colours.

A double convex lens of 20 in. focus, laid on a plain slip of glass, gave a set of beautiful rings. To shew these to advantage, a double convex lens of $2\frac{1}{2}$ in. focus, mounted on an adjustable stand, was used: and the apparatus was placed before a window, so that the rays fell upon the lens at an angle of 30°; the eye being placed on the opposite side, at an equal angle of elevation, to receive the reflected rays. Instead of the plain slip, the plane side of a plano-concave or plano-convex lens of any focal length may be used: or a plain metalline mirror. The rings reflected from a bright metalline surface are fainter than from a surface of glass. In all these cases the form of the upper surface of the superincumbent lens is of no signification: even a common watch-glass will do.

Instead of the surface of the inferior glass, or mirror, being plain, it may be convex: and the form of the superincumbent lens is indifferent, provided the radius of concavity, when concave lenses are employed, is greater than that of the convexity on which they are laid. In like manner, a concave surface may be used for the inferior glass, or mirror, provided the concavity is greater than the convexity of the superincumbent glass.

The coloured rings may also be seen, by transmission, in all

the foregoing arrangements of lenses; either by holding the glasses together, and viewing them against the light, with spectacles; or by using a hollow stand, and placing a candle beneath it, at a proper angle; or by reflecting daylight upwards, from a plain metalline mirror, as practised in common double microscopes.

When two or more sets of rings are to be observed, it is necessary to cast the shadow of some slender body (as of a pointed penknife), in order to examine them critically. When the point of the knife is made to touch the surface of the uppermost glass, it will touch the point of its own shadow, which may be denominated the first shadow, that next to it the second, and so on.

Two, 3, 4, 5, and even 6 sets of concentric rings may be seen at once, by placing several slips, or lenses, upon each other, or upon a metallic mirror; when there is, at the same time, a skilful use made of the shadow of the knife, together with a tilting motion of the lenses, by pressing them alternately more on one side than on the other: agreeably to the well-known observation, that a faint object in motion is sooner perceived than when it is at rest. It will also contribute to facilitate the seeing of two or more sets of rings, if the light is received in a more oblique angle of incidence, such as 40, 50, or even 60 degrees. When several plain slips are employed, they may be placed inclined to each other by inserting a wedge at one end. The use intended to be made of these appearances requires that the sets of rings should be dependent upon each other; but independent sets may also be obtained.

If a slip of glass be placed between two convex lenses, one of 50 inches focus, and the other of 26 inches, two sets of rings may be obtained, the larger of which is from the 50 inch glass, and the smaller from the 26 inch. By tilting the slip, or the incumbent lens, the sets of rings may be made to cross each other in any direction: the small set may be laid upon the large one, or either may be separately removed towards any part of the glass. With the assistance of the shadow of a penknife, the secondary set of the 26 inch lens will be added to the other two sets; but, in tilting the glasses, this set will never leave its primary one, whilst that from the 50 inch lens may be made to go any where across the other two.

As to the size of the rings, curvatures of a short radius, *cæteris paribus*, give smaller rings than those of a larger. This subject, however, has been well treated by Sir Isaac Newton. When two curves are concerned, it is the application of them to each other that will determine the size of the rings; which is also considerably affected by pressure. The rings are larger when the two surfaces that form them are pressed closer together; the smallest ring of a set may be thus increased to double or treble its diameter.

To attempt an absolute measurement of the rings is liable to

great inaccuracy; but by taking a number of measures of any given ring of a set, when a glass of a sufficient focal length is used, its diameter may be determined to $\frac{1}{25}$ or $\frac{1}{30}$ of its dimension. Relative measures of the different rings in each set may be more accurately taken, for in that case the contact of the glass will remain the same, unless disturbed. In examining whether a lens laid upon a metalline surface would give rings equal to what it gave upon glass, it appeared that it could not be brought to the same contact on metal as on glass, nor is it ever to be ascertained whether an equal contact is actually obtained, nor can the colour of the central point hereafter mentioned be easily made equal in both cases.

When the illumination is sufficient, many concentric rings may be seen in each set, in general 8 or 10, and they grow at last too narrow and minute to be perceived.

A double convex glass of 14 or 15 feet focus, laid on a plain slip of glass, yields red surrounded with green; the smallest pressure will change it to green surrounded by red; and an additional pressure produces again a red centre; thus proceeding for six or seven alternations: after which the greatest pressure will only produce a very large black centre surrounded with white. The same alternate changes are observed in the colours seen by transmission, except that the greatest pressure gives a white spot surrounded with black. When curves of very short radius are used, and the lens is pressed on the glass, the rings are alternately black and white; but by lessening the pressure, the centre of the rings may be obtained, white, red, green, yellow, or black, at pleasure; but it requires much practice to manage such small glasses.

A surer way of altering the colours of the rings is by dilution and concentration. Very small lenses give only black and white when in full contact. With a double convex lens of 4 inches focus, the outward rings begin to assume a red colour, which increases as lenses of longer foci are employed. With 16, 18, or 20 inch lenses, green rings make their appearance. This and other colours come on sooner, if the centre is not kept in a black contact. When lenses of still longer foci are used, the central black spot is gradually diluted and drawn out into violet, indigo, and blue, with a little admixture of green; and the white ring which used to be about the central spot is turned partly green, with a surrounding yellow, orange, and red-coloured ring. Huygens' 122 feet lens pressed on a slip (that was probably a little concave), so as to adhere, shewed a light brown ring round a dark centre. His 170 feet lens also shewed the same colour, which has not hitherto been observed in any prismatic spectrum, and resembles that of a certain sort of Spanish snuff.

These colours are always arranged in each set, so that the most refrangible rays are nearest to the centre. If the rings are red and green alternately, the doubt of which is nearest to the centre

may be resolved by a little pressure, or a small increase of the focal length of the superincumbent lens, which will introduce an orange tint that will ascertain the order of the colours.

When two or more sets of rings are seen at once, the colour of the dependent centres will alternate with that of the centre of the primary set; so that if the primary centre be white or green, the dependent centres will be black, or orange, and *vice versa*. There will also be a similar alternation in the size of the rings.

When two sets of rings dependent upon each other are viewed, the colours of their centres, and of all the rings in each set, may be made to undergo a sudden and alternating change, by the approach of the shadow of an opake slender body. The alternation of the colour is accompanied by a change of size. By diminishing the contact, the colour of the centre being changed, the same alternation of colour in the centres may be procured, as in the original black and white centres.

The course of the rays by which the different rings are seen, when a plano-convex lens is laid upon three slips of glass incumbent upon a plain mirror, may be conceived, 1, by supposing an incident ray, after having passed the upper plane surface of the lens, and arrived at the point of contact, to be partly reflected upwards, and partly transmitted downwards to the surface of the next slip, where it is in like manner partly reflected and transmitted, and so on until the mirror reflects the remainder of the ray; by this means four complete sets of rings may be seen. Or, 2, the incident ray passing into the lens, so as to be transmitted on one side of the point of contact, is successively reflected upwards by the surface of each slip, and from the mirror to the point of contact, by which it is again partly reflected downwards to the slips and mirror, and a third time reflected upwards, so as to form four sets of rings. When the centre of the rings is seen at the point of contact, it is a primary set; and when the rays which come to that point, and form the rings, undergo an immediate reflection, Dr. H. calls it a reflected set; and when the rays, after having formed the rings about the point of contact, are immediately transmitted, he calls it transmitted. The secondary and other dependent sets may also be called reflected or transmitted, by a similar distinction.

This course of the rays may be demonstrated by the help of the principle already established, that the colour of the centre of the rings, as seen by transmission or reflection, alternates from black to white, or any other two opposite colours, by the same pressure.

The sudden alternation and change of the colours of two rings by means of a shadow, are obvious from this course of the rays; for if a lens be put upon a looking-glass, it is evident that the primary set of colours (or that whose centre is seen at the point of contact) is seen by reflection, and the secondary set is seen by transmission; and therefore, when the centre of one set is black,

the other will be white, &c. Without a due consideration of this double course of the rays, the colour of the centres of two sets of rings may be frequently mistaken, for, in certain positions, one set may be seen by one light, and the other set by the other. The instantaneous effect of the shadow of an opake body in changing the central colours, may also be easily explained by its abstracting some of the incident rays. And when a person is practised in the management of the rays, by knowing their course, the colour may be changed so gradually that half the centre may be left white, while the other half is changed to black; and the same may be done with green and orange, or blue and yellow centres. The rings of both sets will also participate in the gradual change.

The place where the different sets of rings are seen being at different distances from the eye, they require an adjustment of the eye-glass, in order to see each set well defined. These sets are called primary, when the incident rays come to the point of contact, and form a set of rings; afterwards some of the same rays are continued by transmission or reflection, but modified so as to convey an image of the primary set with opposite colours forward through any number of successive transmissions or reflections; and thus, whenever this image comes to the eye, a dependent set of rings appears, which follows the motions of the primary set. Their dependency is also shewn, by changing the obliquity of the incident light, for the centres will recede by an increase of the obliquity, and approach by a diminution of it; so that if the incidence is nearly perpendicular, the dependent sets of rings may be brought almost under the primary set.

Several sets of rings may sometimes be seen with the same coloured centre, but these sets are not all dependent upon the primary set which is seen, but on another invisible primary set: this illusion may be destroyed by exposing the apparatus to a brighter light, and increasing the obliquity of the angle of incidence.

Dr. H. relates a great number of experiments made in order to discover which of the surfaces in the complex arrangement of glasses were efficient. These experiments were made by using slips of glass, lenses or mirrors, having scratches on their surfaces, and in various other manners, for the particulars of which we must refer to the paper, as it is impossible to explain them properly without diagrams.

From these experiments he concludes, that only two surfaces are essential to the formation of concentric rings; but these two surfaces must be of a certain regular construction, so as to form a central contact; and the rays must either pass through this point of contact, or through one of the surfaces about the same point to the other, to be reflected from it. The rings thus formed have their common centre in the place where the two surfaces touch each other. The colour of the reflecting and transmitting sur-

faces, when coloured glasses were employed, did not affect the form of the rings, but gave a strong tinge to the centres of them.

Sir Isaac Newton ascribed these phenomena to a disposition of the rays of light to be alternately reflected and transmitted; but in one of the most simple methods of obtaining these concentric rings, by laying a convex lens upon a plain metalline mirror, there is no transmission of the rays.

A 39 inch double convex lens was placed upon a slip of glass 5,6 inches long, and 2,3 thick, and this placed upon a plain metalline mirror; a narrow strip of the paper usually put between prints, and which was about the 640th part of an inch thick, being inserted at one end. By this arrangement the rays that convey the secondary set of rings to the eye must pass through a thin wedge of air, whose length was 5,2 inches. As therefore the rings of the secondary set extended over a space of ,14 inch, they should suffer more than seven interruptions of shape and colour in the direction of the wedge of air. But on moving the convex lens from one end gradually to the other, the 3d, 4th, and 5th rings, which were extremely distinct, retained their shape and colour without the smallest alteration. The same experiment was repeated with a piece of plain glass instead of the metalline mirror, in order to give room for the fits of easy transmission to come into action, but the result was still the same.

Neither did the alternate fits of easy reflection and easy transmission exert themselves according to the various thickness of thin plates of glass; for a plate of coach-glass 17 inches long, ,33 in. thick at one end, and ,32 in. at the other, which regularly tapered from one end to the other, was selected, and placed upon a small metalline mirror. A double convex lens of 55 inches, laid upon this slip, gave the usual two sets of rings, of which the secondary set had 12 distinct rings, and the central space was about $1\frac{1}{2}$ times as broad as the 12 rings on either side, the mean breadth of a ring being about the 308th part of an inch. Now, according to Sir Isaac Newton's calculation, the 12 rings, as well as the central colour of the secondary set, should have been broken by the exertion of the fits, at every 80th part of an inch; but when the glass plate was drawn gently over the mirror, the shape and colour of the secondary rings, which were always kept in view, were completely well formed. In a similar experiment, with a small plain glass instead of the metalline mirror, the same results were obtained, but only six rings could be distinctly seen in the secondary set, on account of the inferior reflection of the subjacent glass.

The experiment, however, which most particularly opposes the admission of fits of easy reflection and easy transmission of rays, was varied from one of Sir Isaac's. He observed that a beam of light, admitted into a dark room upon a concave glass mirror

placed at twice its focal length from a chart, gave four or five concentric irises, or rings, of colours like rainbows. He attributed these rings to the alternate fits; and the Duke de Chaulnes, as also Mr. Brougham, attributed them to the action of the first surface of the mirror. To avoid two surfaces, a 7 feet metalline mirror was placed at the distance of 14 feet from a white screen, and a beam of the sun was admitted through a hole in the middle of the screen, so as to fall perpendicularly upon the mirror. Some hair-powder then being strewed with a puff into the beam of light, the screen was suddenly covered with concentric circles displaying all the brilliant colours of the rainbow. These rings contracted when the hair-powder was strewed into the beam at a greater distance from the mirror, and dilated when the powder was brought nearer. So that the rings evidently arise from the flection of the rays of light on the particles of the floating powder, modified by the curvature of the reflecting surface of the mirror; as the principle of thin or thick plates, either of air or glass, on which the rays might alternately exert their fits of easy reflection and easy transmission, has no existence in this place. And of course all the theory relating to the size of the parts of natural bodies and their interstices, which were founded by Sir Isaac Newton upon that principle, will remain unsupported; and another basis must be sought for it, which may be found in the modifying power which the two surfaces that are essential to the formation of the rings, exert upon the rays of light.

Dr. H. therefore intends to prosecute the subject in another paper, and to examine the various modifications that light receives in its approach to, entrance into, or passage by, differently disposed surfaces or bodies; in order to discover the immediate cause of the rings.

Observations.—It is our sincere wish to treat the communications of this distinguished philosopher with that respect, which the unwearied exertion of so much labour and so much ingenuity, crowned, as they often have been, by the most brilliant success, must undeniably be allowed to demand: we have not indeed always been able to assent to his opinions, but we should be sorry that any observations, which may have escaped us in the course of our criticisms, should be thought inconsistent with the deference due to authority so high. After having premised this explanation of our sentiments, we shall think ourselves at liberty to animadvert with the more freedom on the paper before us, which we cannot consider by any means as adding to the value of those treasures of science, which have, in the course of years, been accumulated in the Philosophical Transactions.

Dr. Herschel seems to have confined his study of the pheno-

mena of light almost entirely to the works of Newton, not thinking it worth his while to inquire whether the last hundred years had produced any thing deserving his attention, and taking it also for granted, that little or nothing was known before him. But, in fact, the colours of thin plates were by no means the "discovery" of Newton; they have been described with great accuracy by the ingenious, but too much neglected, Dr. Hooke: and when Dr. Herschel observes other "modifications" of light that are not precisely described by Newton, he very hastily concludes, that they have been "totally overlooked" by all later authors.

The principal novelty in these experiments appears to be the unnecessary complication that is introduced into them: the rings, exhibited by a series of successive reflections, are confessedly repetitions of those which Newton observed in a simpler form: and from this complication Dr. Herschel obtains only *fumum ex fulgore*.

We do not wish to be considered as strenuous defenders of the Newtonian fits of easy transmission and easy reflection; but we will venture to maintain, that Dr. Herschel has advanced no one argument that can have any weight in lessening the probability of their existence. He asserts, that when a lens is laid upon a metallic mirror, there is no transmission of the rays; but the absorption, which he is not unwilling to admit, at the surface of the mirror, is in fact to be considered as a species of transmission. Nor had Dr. Herschel any reason to expect a sensible change in the appearance of the rings, when they were viewed through the wedges of air and glass which he describes, since those wedges were much too thick to produce any observable colours in white light, and for the very same reason too thick to produce any perceptible interruptions in the rings; the effects of the interruptions of two portions of light, differing but a very little in refrangibility, being so different as to counteract each other.

The experiment, made by strewing particles of hair-powder in a sunbeam, is still more unconnected with the question: because the rays of light undergo certain flexions and modifications in the neighbourhood of bodies near which they pass, it surely does not follow that they are not liable to other modifications at the surfaces of transparent bodies. In fact these colours are identical with those of the coronæ described by Mr. Jordan and other authors, and have no immediate connexion with the colours of thin plates. If we might be allowed to suggest a hint on the subject to the ingenious author, we would beg him to reconsider well his own experiments and those of Newton, and to inquire whether no other writer, ancient or modern, has made any experiments, or proposed any theories, which may tend to the illustration of this difficult subject. Propositions have, if we mistake not, been laid down by more than one author, so generally and so

confidently, as to require at least something like a confutation before a new opinion is advanced, which, as Dr. Herschel threatens, is to supersede them all.

Account of an extinct Volcano, in Britain. By Mr. DONOVAN.—*Phil. Jour. No.* 83.

THE mountain, of which Mr. Donovan speaks in this communication, is *Cader Idris,* situated in the county of Merioneth, which, in point of size, is esteemed the most considerable in Wales, Snowdon alone excepted.

It is about seven years since Mr. Donovan first concluded, from the general appearance of this mountain, that it was once volcanic. In 1807 he examined it more minutely, and has completely confirmed his original opinion. In support of it, Mr. Donovan has now added to his museum, at Lambeth, abundant examples of different sorts of lava, pumice, and other volcanic matters, of the most unequivocal character, collected by himself from the sides and base of the mountain; and also a suite of the most remarkable and singularly formed columnar crystals of basalt, that are scattered in profusion about the loftiest summit, and cliffs surrounding the crater.

The general aspect of this crater is exactly that of Mount Vesuvius, except that one of its sides is broken down; by which means the abyss of this funnel-shaped excavation is more completely disclosed than in Vesuvius: and it is this side of Cader Idris which affords the most illustrative examples of porous stones, these forming immense beds on the declivities, a few inches only, in many instances, below the surface of the earth. Many of these porous stones, lately found in this spot by Mr. Donovan, exhibit evident marks of strong ignition and vitrification; some are reduced to the state of slags, while others have all the cellular appearance and lightness of pumice.

The present appearance of the crater manifests an origin from the violence of an explosion. In confirmation of this idea, it is mentioned that the summit of the mountain is covered with an immense wreck of the stones, as if ejected from the crater at the time of this explosion: it would be difficult to account in any other way for the vast profusion of those stones, scattered in all directions about the loftiest elevations, and which, from the confused manner in which they are dispersed, must have been thrown into their present situation by no small violence. Myriads of these stones have borne a regular crystallized form, though, from their great bulk and weight, they have for the most part suffered material injury in the general convulsion. The usual length of these crystals is from 3 to 6 or 10 feet in length: though some measure more, and one in particular, which Mr. Donovan saw,

was 22 feet 3 inches long. Specimens of these stupendous crystals are now to be seen in the museum of this industrious naturalist.

Observations.—We need only add here, that the evidence adduced by Mr. Donovan, in support of this curious fact, is sufficient to convince every unprejudiced mind; and that no person need hesitate to admit the truth of the general statement, since it is well known there are extinct volcanoes in America, and no satisfactory reason can be assigned why they should be confined to that quarter of the globe.

On a Kind of Death that may be presumed to be only apparent.

By M. Du Pont de Nemours.——*Archives Littéraires, Vol. XIII.*

Every one knows that the effects of heat and cold vary according to the nature of the bodies that are exposed to them. Less heat is required to liquefy lead than steel, and less still serves for frozen water: while, on the contrary, a far greater degree of cold is requisite to congeal mercury than would be required to freeze water.

So again, some vegetables are not killed by the severest frosts; our native trees lose their leaves in winter, many herbs their stalks; while some trees revive with the return of spring, although even their roots have been frozen in the winter.

If we proceed to animals, we see ants, flies, and other insects, sleep, or indeed appear dead, with a slight degree of cold. In the class mammalia we have dormice, marmots, &c. in which life seems to be suspended when cold approaches: and this suspension of life is so complete, in some of the species, that their heart ceases to beat for whole months. Several serpents exhibit a phenomenon still more surprising: they can be so frozen as to become brittle, and die if they be broken in this state; but if they be left in their holes, into which the warmth of spring penetrates by very slow degrees, they revive, and fully prove that they were not dead.

It is uniformly observable, that little fructivorous animals sleep first; then the larger and carnivorous. Those that would be deprived of food by its being covered with snow, sleep till the snow melts, or rather longer. Hence also the white bear retires later than the black bear, or even than the brown. That hunger should cease in these animals at the period when famine would take place, and in consequence of the same degree of temperature, is certainly a great benefit conferred on them by that Intelligence which regulates every part of the universe. If they retained their energy they would perish from inanition. They are unac-

quainted with want; they feel not its pains; they incur not its danger. Nature saves them from it by that axiom, which has commonly been considered as a jest, that *He who sleeps, dines.* This stupor is not painful, but pleasurable: not a disease, but friendly to life; and renders living bodies more capable of retaining heat, by diminishing their conducting power.

When the cold is so increased as to become too violent, man is insensible to it. If one of his limbs freeze, he does not perceive it till others inform him of it; as is very common in Poland and Russia. On the contrary, he fancies himself at length growing warmer; and if no one of his limbs be more affected than another, his state seems pleasurable: he feels a seducing and delightful propensity to sleep: he is angry with his friends, who urge him to walk on: he entreats them to let him close his eyes for a few moments; and, if they yield to his importunity, he falls asleep, and appears dead like a dormouse.

Is it unnatural to suppose that in this case the man's death is only apparent, like that of other animals; although it might end in the complete extinction of life? for instance, after his fat were consumed, if he were not frozen as well as asleep; or, after the habit of the vital functions had been entirely destroyed by a frost too severe, or of too long a continuance, so as to stop the alimentary transfusion of the fat, or stiffen the organs to such a degree, as to cause an absolute cessation of their secret movements; which appears to be an accident to which the mammalia are liable, though some of the serpents and gelatinous animals are not.

Let us reason from a part to the whole. In cold climates the nose, ears, hands, or feet, are not unfrequently frozen. If this be not quickly remedied, the contrast between the living state of the rest of the body and the incipient death of the limb attached, occasions this limb to sphacelate: nature cuts it off by the strenuous resistance of the contiguous and threatened limb. If hasty means be adopted to remedy it, the too rapid distention of the capillary vessels, by the fluids contained in them, ruptures their sides, and extravasations take place; the communication, instead of being restored, is thus completely interrupted, and a gangrene is induced from the same cause.

The effects on vegetables are similar, and so is the mode of restoration. If the limbs of animals be thawed with cautious slowness; if the part frozen be removed from the extreme cold it has experienced, to a less degree of cold; if it be rubbed with snow, then immersed in the water of melting ice, and this be suffered to warm gradually, at first by the mere contact of the contiguous unfrozen portion of the limb, the part frozen will recover its local vitality. The cure may then be completed by very small successive additions of water, a little warmer than that by which the part was thawed, and thus the limb be saved.

It is perfectly agreeable to analogy to believe that similar treatment would succeed when the affection is general: and indeed there are many well-established facts which support the opinion. The method recommended by Portal, in his work on Asphyxies, is good; but probably too hasty: for, it may be presumed that a general affection, being more serious than an affection merely local, must require still more circumspection in the progressive graduation of the means employed: the rupture or even aneurism of a few vessels might have much more fatal consequences in this case.

The path, however, is now opened, though not sufficiently explored. Experiments have not been repeated sufficiently, or with due regularity: they have neither been so scientifically directed, nor so scrupulously described, as the case requires. M. Du Pont de Nemours recommends the ascertaining, whether man be in fact, like the bear and the marmot, an animal that cold benumbs and lays asleep without killing; whether it be true, that he can endure being completely frozen, like the serpent; and whether in this extreme case a gently graduated warmth, applied in time, and slowly developed, would restore life.

We see that several animals destitute of vertebræ, among those with vertebræ, serpents, and among the mammalia a great number of the smaller species with cutting teeth, sleep three or four months, or even more, in a very moderate degree of cold: that a greater degree, and this in different proportions, is required for the general species of bears, of which too the sleep, in this state of imperfect death, does not appear to be so profound, or the suspension of life so complete: that man falls asleep in a still greater degree of cold: that it is more than probable, nay almost certain, that judicious means, prudently administered, would be capable of awaking him from this dangerous sleep, so near akin to death: and that it might be the same with other animals, or indeed with all animals which are rendered torpid only by a degree of cold still greater than that which deprives man of the appearance of life.

M. Du Pont de Nemours concludes by recommending, that the minutest particulars relative to this subject should be collected.

Observations.—We earnestly unite with this ingenious author, in recommending the collection and classification of every particular connected with this interesting topic of inquiry. We have long been persuaded, that in many of the cases of supposed death, occasioned by extreme cold, the unhappy subjects had merely been reduced by the great diminution of temperature to that state of torpidity, which, though indeed near akin to death, is for a considerable time distinct from it, and admits of restoration by the judicious application of appropriate means. The humane exer-

tions of the philosophers of the last century have abridged the empire of death, by snatching from his grasp many in whom the vital functions had been suspended by drowning, or by suffocation by carbonic acid. The means employed in these two classes of cases are directly opposite; but not the less successful on that account. The means to which recourse must be had in restoring animation, when suspended by extreme cold, are completely different from either of the above; but most of them are suggested by an obvious analogy, from considering the method of restoring frozen vegetables, frozen meat, or fishes: warm water would convert a frozen vegetable to a state of rottenness, and frozen meat nearly to that of putrefaction, while cold water or snow will restore them to their proper state. Pike taken alive from a pond, and laid upon its banks till they are completely frozen, as hard as stakes, and to all appearance lifeless, may in this state be carried miles; and then, on immersion in cold water, be soon restored to life and activity.

A very slow and gradual augmentation of temperature, with proper friction, has restored from this apparent death, some who had been torpid for hours. And, in the case of Mrs. Woodcock, the poor villager, near Cambridge, which occurred 6 or 7 winters ago, the sufferer had been covered with snow 8 days, and was in a state of torpidity the greater part of that time. She was, notwithstanding, restored to the complete use of her faculties, and probably would have been to that of her limbs, were it not for the too rapid transition from extreme cold to a warm room, and for the fatigue arising from daily and hourly visits of inconsiderate persons, drawn about her merely to gratify curiosity. She lived nearly half a year after her deliverance from the snow. We would beg to recommend, as intimately connected with the present inquiry, Mr. Okes's curious pamphlet describing her case, and the means employed for her recovery. The operation of cold, as experienced by Dr. Solander, Sir Joseph Banks, &c. and described in Captain Cook's Voyages, will also serve farther to illustrate this important subject. We will only add, that, though in many, perhaps in most, instances of torpidity through cold, we have no doubt that the activity may be restored; yet we suspect this would not *always* happen, even under the most judicious treatment: may it not happen, or rather must it not sometimes happen of course, that when the blood in the smaller vessels towards the surface of the body, and that in the larger vessels, at the extremities, is congealed, a greater portion of this fluid will, by reason of such defect in the circulation, be forced into the head, and by this unnatural determination to the brain, produce death, as if by *apoplexy?* We only start the question here: we have not room to pursue it.

Remarks on Torpidity in Animals, in two Letters from JOHN GOUGH, *Esq.—Phil. Jour. No.* 83.

THESE communications were suggested by the perusal of the curious paper on the torpidity of animals, and an apparent kind of death, occasioned by cold, by M. Du Pont de Nemours, an abridgment of which is given above.

Mr. Gough commences by stating the prevailing opinion entertained by M. Du Pont de Nemours in common with most other philosophers respecting the nature of torpidity. It is referred, partly to the benumbing effects of the cold which prevails in winter, and partly to a high degree of corpulence, which is generally contracted in autumn, from an unrestrained indulgence in the abundance and delicacies of that season. It is farther supposed, that animals do not submit to this long suspension of the vital functions in obedience to the dictates of necessity: but that they court a lethargic habit, in consequence of certain pleasing sensations which are known to precede the first moments of sleep.

Against this hypothesis Mr. Gough advances four objections:

1st. Animals do not submit to torpidity upon choice, but from necessity; and when cold happens to be the immediate cause, they fly from it, if possible.

2d. Certain animals apparently support a voluntary suspension of their functions in summer as well as in winter, when food is withheld from them: this is probably intended to preserve life by diminishing the action of the system.

3d. A quadruped, noted for its lethargic disposition in winter, may be so far strengthened by a generous diet, as to retain the full use of its faculties during the time of a severe frost: from which it is inferred that an emaciated habit of body is the predisposing cause of torpidity, in opposition to the common opinion, which assigns this office to corpulence.

4th. The united action of hunger and a low temperature has produced a kind of apparent death in a human being, who was restored to life by stimulating remedies, after lying several days without sense and motion.

The hearth cricket *(gryllus domesticus)* affords a proof of the first objection. This insect passes the hottest part of the summer in sunny situations, concealed in the crevices of walls, and in heaps of rubbish. It quits its summer abode about the end of August, and fixes its residence by the fire-side of the kitchen or cottage, where it multiplies its species, and is as merry at Christmas as other animals are in the dog-days. The comforts of a warm hearth afford the cricket a refuge, not from death, but from temporary torpidity; which it can support for a long time, when deprived by accident of artificial warmth.

To establish the second objection, Mr. Gough took several specimens of the garden snail *(helix hortensis)*, and shut them up in a perforated wafer box; which secluded them from food and water, but not from air. A number of the *helix zonaria* was treated in the same manner; and a few of this species were put into a bottle, which was corked, to cut off all communication with the atmosphere, as well as food and water. Those snails did not live long which were deprived of air; but the specimens of both species did not die which were confined in the perforated boxes. On the contrary, they retired into their shell, closing the apertures of them with thin membranes; and here they remained dead to all appearance, as long as they were kept dry. But this death was only apparent: for Mr. Gough restored his prisoners to life in succession, by dropping them into a glass containing water of the temperature of 70° or 72°: after leaving them 4 or 5 hours in this situation, he constantly found them alive, and sticking to a plate which covered the vessel. A large garden snail supported this severe confinement nearly three years, being apparently dead all the time; after which it revived on immersion into water, like the rest of its fellow-captives. An aquatic species of snails *(the helix putris)* will not, however, survive this kind of treatment.

Mr. Gough's proofs of the 3d and 4th objections are contained in a letter he sent, in Oct. 1798, to the Society of Nat. Hist. Edinburgh; not then knowing that the Society was not in the habit of publishing its papers.

He describes the manners of two dormice *(mures avellanarii)* recently caught; but which were killed by improper treatment. In April 1793 he obtained a third dormouse, fresh from the woods: former experience taught him to manage this in a manner more congenial to its constitution; for in addition to nuts and biscuit, it was constantly supplied with green hazel-buds, or raisins, in spring; with ripe fruits, particularly cherries and pears, in summer; and with apples and raisins in winter. This generous diet not only preserved the creature in health and high condition, but appeared to fortify it against the benumbing effects of cold, which it supported the following winter much better than the other couple had done formerly: for it never slept more than 48 hours (and that but seldom) without visiting the cup which contained its provisions.

Mr. Gough then began to suspect the torpidity of the dormouse in the wild state, to be nothing but a custom imposed by necessity on a constitution which nature has intended to retain life during the cold season of winter, with but little food, and an imperfect degree of respiration, as well as a languid or perhaps a partial action of the sanguiferous system. The uncommonly severe weather which ushered in the year 1795, confirmed the foregoing opinion apparently beyond exception: for a constant use of a generous and plentiful diet had by that time completely

conquered the torpid habit. Notwithstanding the hard frost of January that year, the animal braved the cold with wonderful indifference: for it awaked every evening, and consumed, in the course of the night, a quantity of food amounting to 100 or 120 grains, and frequently gnawed the ice which covered the water in the cage: it even undertook, in the coldest part of the month, to repair its nest, which happened to receive an injury, and perfected the task in one night.

Mr. Gough having thus shewn that a quadruped, remarkable for its torpidity, may be rendered active at all seasons by a plentiful and generous diet, states it as probable that a contrary regimen, properly managed, might incline an animal, no less remarkable for its activity, to become torpid at times. Some singular anomalies in the history of man himself, may be said to indicate an incipient propensity to become torpid under certain circumstances. There are instances of great insensibility arising from the operation of causes on the system, which have an evident tendency to destroy the vital power, or which incapacitate the brain to generate this power in sufficient quantity to supply the various demands of the voluntary and involuntary functions: the little that is produced being expended on those operations of the economy which are absolutely necessary for the continuance of life.

A case related by Dr. Plot (Hist. of Staffordshire, chap. viii. sect. 36) will serve as a proof of the 4th objection: A poor girl, eight years old, being beaten by a severe stepmother, and then sent hungry with some refreshments to her father in the fields, could not refrain from eating part of them. Reflecting afterwards on the probable consequences of her conduct, she proceeded no farther on her way, but retired to a neighbouring wood, and there fell into a profound sleep, being oppressed with fear and sorrow. In this state she remained *seven* days, and, when discovered, shewed no symptoms of life, besides the softness of her flesh and the flexibility of her joints. Dan. Ludovicus, from whom Dr. Plot borrows this relation, happened to be present, and succeeded in his attempts to recover this poor creature. He first washed a glutinous phlegm from her face with warm water, and cleared her mouth and nostrils from a viscid substance that obstructed them: a few spoonfuls were then administered; after the second she was heard to groan; after the third she opened her eyes; and so came at length to herself by degrees. The same author (Dr. Plot) has also preserved another instance of a sleeper in the circle of his own acquaintance; namely, Mary Foster, of Admaston; but her singular case is too imperfectly recorded, to ascertain any thing more than the fact and cause of it. She remained in a profound sleep for fourteen days and nights, after an equal period of fear and anxiety, occasioned by her having fallen casually into a well; and the accident seems to have produced in her a disposition to torpor: for two years afterwards she slept two nights and a day at

Uttoxeter; but the reason of this relapse is omitted. The annals of medicine doubtless furnish many more examples of a like nature; but these appear sufficient to prove, that torpidity is a mere habit, and not a constitutional principle of the animal economy.

Observations.—The facts stated by Mr. Gough in these papers, are highly curious; but we think they are scarcely sufficient to establish his theory, or rather to overthrow that embraced by M. Du Pont de Nemours. May not the phenomena of torpidity, when considered relatively to their causes, be other instances of the truth of the observation that *extremes meet?* It is obvious that great heat will produce drowsiness, as certainly as that extreme cold produces torpidity. And it is more certain, or at least it is more consistent with general observation, that repletion produces inactivity and torpidity than that the opposite extreme does. At present, however, the grand object should be, to collect facts on this interesting subject; for we are as yet far from the state in which we can theorize upon it correctly.

On that Power of the Eye, by which it is adjusted to see Objects distinctly at different Distances. By Ezekiel Walker, *Esq.*—*Phil. Mag. No.* 116.

Mr. Walker asserts, that none of the hypotheses hitherto advanced respecting the accommodation of the eye to different distances, have been demonstrated, and that this property of vision seems still to remain in obscurity. His own opinion is, that the change of the iris is sufficient to explain the phenomena; he thinks both the crystalline lens and the vitreous humour too dense to admit any considerable change, especially the vitreous humour, which he says adheres closely to the crystalline, in order to preserve its lenticular form; and any alteration of the whole globe he rejects, as inconsistent with "those beautiful mechanical laws which are seen in every other part of the animal economy." His first three observations are intended to prove, "that we have no perfect vision but by rays which enter the eye in a direction parallel to the axis of the crystalline lens; which he thinks is demonstrated by the indistinctness of every object to which the eye is not immediately directed, and of a small point brought near the eye, except when viewed through a minute aperture;—and he observes that "all rays that fall upon a convex lens parallel to its axis are converged to the same point;" and consequently "when an object is seen distinctly, its image is painted at the same invariable distance from the crystalline lens, whether the object be near or remote."

Mr. Walker next advances three experiments made with a lens of 24 inches focus, and a piece of ground glass placed at the opposite ends of a tube, to represent the crystalline lens and the retina. When the aperture of the object-glass was two inches, the picture of remote objects was distinctly painted on the glass, and nearer objects were represented imperfectly. When the aperture was contracted to half an inch, near objects were represented very distinctly, but the picture of remote objects was less conspicuous; and upon contracting the aperture to one fifth of an inch, " all outward objects appeared indistinct; but a plumb line, which hung down the middle of the window, was clearly represented upon the artificial retina."

A more simple experiment is finally adduced, which is supposed to afford an additional proof in favour of the same opinion. When a remote object is viewed through a hole about one fiftieth of an inch in diameter, and a pin is also held at the distance of a few inches in the same direction, they both appear extremely distinct, but upon removing the aperture, the pin becomes indistinct, while the remote object remains as distinct as before. " Hence," says Mr. Walker, " it is as clearly proved as any proposition in optics, that the rays issuing from a near object, after having passed through a small aperture, are conveyed to the same point upon the retina as those from a remote one; the rays from both objects being nearly parallel."

Observations.—We are not disposed to question the utility of the unprecedented increase of the number and magnitude of the periodical publications, which makes so striking a feature of the literature of the last twenty years: on the contrary we think, that, in an age of investigation, the facility which they afford, not only to the circulation of established truths, but also to the proposal of ingenious suggestions, which their authors would not even have weighed with attention, but for the stimulus of preparing a communication for the public eye, must, in many instances, tend to the ultimate promotion of science. But we cannot help regarding it as, in some measure, derogatory to the character of a respectable journal, and, at the same time, discreditable to the literary reputation of the country, that papers should be brought forward, without censure and without comment, which betray the deficiency of their authors in the first elements of science;—and we must maintain, that it is carrying the modern improvements of elementary education much too far into our studies, if we determine to go on continually upon the system of writing before we read.

These remarks have been unavoidably suggested to us by the paper of which we have given an account: if Mr. Walker would or could have read and understood the works of the authors whose

names he mentions, we think it highly probable that he would not have been of opinion "that none of the hypotheses hitherto advanced have been demonstrated;" and we are perfectly confident that he would not have written this essay.

With respect to the density of the crystalline lens, and still more with respect to that of the vitreous humour, Mr. Walker is extremely mistaken: but this being a matter of observation, and not of reasoning, his error is the more excusable. When, however, he says that all parallel rays falling on a lens are collected in the same focus, and includes under the definition of parallel rays such as are transmitted through a small orifice, although proceeding from a point at a small distance, he makes an assertion which is directly contradictory to the mathematical laws of optics; laws which are as unquestionably demonstrable as any proposition in the elements of geometry.

It is true that when the surfaces of a lens are perfectly spherical, its mean focal length is altered in a very slight degree by a change in its aperture; but this change is in all practical cases absolutely insensible, and, unfortunately for Mr. Walker's opinions, is of a nature precisely opposite to that which he takes for granted.

One simple argument is sufficient to set aside these opinions; it is founded on an experiment well known to all those who have properly studied the subject. If we look through two minute holes, much nearer together than the diameter of the pupil in its most contracted state, at one of two points, nearly in the same line, and within the limits of perfect vision, the other point will always appear double, whether we fix on the nearer or the more remote for the object of our attention. Here there is no change of the aperture, but a true alteration in the refractive powers of the eye.

It is obvious that Mr. Walker's three experiments with the lens prove a great deal too much; they demonstrate that a contraction of the aperture makes a remote object appear indistinct, while, in the next page, we are told, that, when we view a remote object through an aperture of about one fiftieth of an inch in diameter, "if the object be seen in a proper light, it will appear as distinct as to the naked eye." What must be the confusion of that man's ideas who could fail to discover so glaring a contradiction? The true explanation of the paradox, supposing the appearances to have been correctly described, is this; the light admitted was diminished by the contraction of the orifice, from 2 inches to $\frac{1}{5}$ of an inch, in the ratio of 100 to 1; consequently the pictures of all distant objects must have been rendered extremely faint: but the image of the plumb-line in the window was rendered distinct by the contraction, as it would have been by the contraction of an aperture without any lens, which would have exhibited a shadow nearly as distinct, without any trace of a picture of the remoter

objects. Mr. Walker's inference, therefore, unavoidable as it may seem to a superficial reader, is totally founded on a mistaken conception of the nature of the experiments; and the whole paper tends only to prove his ignorance of the actual state of a controversy which has so much engaged the most celebrated opticians.

A Method of finding the specific Gravity of Light from Analogy; and the undulatory System defended by an Experiment on inflected Light. In a Letter from Mr. RICHARD WINTER.—*Phil. Journ. No.* 82.

MR. Winter observes, that few discoveries have been made by following a beaten path, and that notwithstanding the exertion of Newton's extraordinary abilities in favour of the emanative system, Dr. Young's late experiments, and reasoning from facts, in favour of the undulatory motion of light, are deserving of impartial attention. He thinks that the density of light may be determined, or at least estimated, upon the principles of this system, from a comparison of its velocity with that of sound; the velocity of undulating air being to that of undulating water, according to Hales, in the same ratio as the respective specific gravities; whence the velocity of sound being 1130 feet in a second, and that of light something more than a thousand million, it follows that atmospheric air must be 894,588 times heavier than light, and 1553 cubic feet of light must weigh only 1 grain. He infers that the momentum of the light thrown on the arm of a balance by a lens must be utterly insensible: yet he thinks that this same momentum "may have very considerable effects when exerted upon the body of the planets," and may possibly be the cause of their diurnal motion.

Mr. Winter is of opinion that the Newtonian experiment, in which a beam of light is admitted into a room through a small aperture, and the shadow of a body placed in it is considerably enlarged, may be much better explained on the supposition of an undulatory than of a radiating motion of light. For since it is the nature of an undulation to diverge, the beam must be divergent, and the shadows consequently enlarged, while, on the other hand, if the divergence of the beam were occasioned by the attraction of the sides of the aperture, the opake object would also attract it, and its shadow would be diminished instead of being increased.

Observations.—We fully agree with Mr. Winter, that the arguments which have lately been advanced in favour of the undulatory system of light require an impartial consideration; but we much doubt whether the reviver of that system will be at all flattered by the acquisition of converts such as Mr. Winter: we suspect he

will be disposed to exclaim, "*Non tali auxilio, nec defensoribus istis.*" Never did the pupil of the philosophers in the clouds introduce a more glorious confusion into the adoration of the ethereal vortices of the Socratic sages, than this new Strepsiades has created in the doctrine of the ethereal medium of the modern school.

Mr. Winter seems to forget that sound is not air, nor even wind, and he is not aware that it is as absurd to admit the undulatory system, and to expect a body, however minute, to be propelled by light, as to suppose that a first-rate man of war could be wafted across the Atlantic by the sound of the clock at St. Paul's. The density of light implies also, upon the same supposition, as great an incongruity of ideas, as if we spoke of the weight of sound. The analogy, such as it is, between the undulations of air and water, would lead, if it were correct, to the density of the medium which is supposed to undulate, when agitated by a luminous body: but the observation on which it is founded is utterly erroneous.

The brief hint thrown out by Hales must have been derived from the accidental result of some very imperfect experiment, which he does not describe; but Mr. Winter might have learnt, either from Newton or from the syllabus which he quotes, that the velocity of an undulation varies as the square roots of the density of the medium and of its elasticity conjointly; consequently, without some measure of the elasticity of the supposed medium, it is utterly in vain to attempt to determine its density. He might, however, in some measure have satisfied his curiosity by a conjectural estimate of Newton, whose slightest suggestions are generally of more value than the calculations of most other men. He is speaking, in one of his queries, of a medium, the undulations of which he supposes to be a little more rapid than the motion of light; and he observes, that "if this ether should be supposed 700,000 times more elastic than our air, and 700,000 times more rare, its resistance would be above 600,000,000 times less than that of water. And so small a resistance would scarce make any sensible alteration in the motions of the planets in ten thousand years." Optics, Qu. 22; or Young's Nat. Ph. ii. 615.—Dr. Young confesses, however (p. 682), that this assertion respecting the disturbance of the planetary motions is not perfectly accurate; but he seems to think that there is no difficulty in supposing the rarity of the medium as much greater as astronomical observations may require, and its elasticity smaller in the same proportion.

With respect to the supposed effect of the momentum of light so constituted on the planets, it may be answered, first, that light has absolutely no momentum; secondly, that if it had any momentum, it could produce no rotatory motion, falling equally on both sides of the axes; and thirdly, that if it could produce any

rotatory motion, it would either accelerate or retard the existing rotations, and they would not be uniform, as they actually are. Mr. Winter has really shewn some *talents* in *building* up such a *triple wall* to run his head against.

Nor is he at all more happy in his reasoning upon the Newtonian experiment in a dark room. The phenomena, as he has stated them, may be very sufficiently explained upon the Newtonian supposition, that of the light, which passes within a certain distance of the opake body, some is attracted towards it, and some repelled from it, that which passes nearest to the body being more affected than that which passes at a greater distance. The real difficulty consists in admitting the operation of the opake body on light so remote from it, as some of that which is shewn by the experiment to be affected; and the indifference of the nature of the substance, which casts the shadow, to the result of the experiment. For, granting with Newton the identity of the inflective forces with the refractive and reflective powers, it seems to follow, that a most striking difference ought to be produced in the phenomena of inflection, according to the refractive density of the inflecting substance; and from the very sensible distance at which the inflective force must be supposed to act, it would be expected that its operation would be very much increased by an increase of the magnitude or of the radius of curvature of the bodies concerned. These remarks we advance not as entirely new or conclusive, but as being the most natural for Mr. Winter to have made, if he had been capable of justly estimating the difficulties which attend the subject.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, DURING THE MONTHS OF JANUARY, FEBRUARY, AND MARCH, 1808.

Mr. Obadiah Elliott's *Patent for Improvements in the Construction of Coaches, Chariots, and other Carriages.—Repertory of Arts, No. 68, N. S.*

The improvement in four-wheeled carriages proposed in Mr. Elliott's specification, consists principally of a method of construction, by which the necessity of perches seems to be superseded. In the most useful, and probably the most elegant, construction, a spring bed is properly adapted below the boot of the carriage, or the coach-box, and another projects from the back part of the carriage, so as to serve at the same time for the footman's stand or platform. The fore and hind springs are posited beneath these beds, and are fastened to them by bolts, &c. at the

middle of each upper spring. The fore and hind springs on each side of the carriage are similar to those called grasshopper-springs, being in the shape of circular arches, which present their concavities towards each other in such manner that the chords of the arches shall be horizontal. These springs are connected at their extremities, by coupling plates, and blocks with oval or other shaped holes, in the bottom spring, to prevent the coupling plates from turning round. The centre of each spring lies over the axletree of the fore and hind wheels respectively: and the front springs have between them and the front frame large horizontal rings, to facilitate the turning of the carriage. The futchels that support the spindle-bar and pole are fastened to the lowermost of these rings; and the bolt or pin, connecting the fore wheels and springs with the body, is inserted into the frame-work through the centres of the two rings.

In another construction, the front springs and horizontal wheel are the same as described above; while there is an iron loop or socket projecting down from the bottom of the body, under the carriage-door, to receive one end of a spring, whose other end reaches to the axletree, and is there fixed. There is a cross spring bolted on the bottom of the body, and fixed across or underneath the spring just mentioned by loops, sheckles, or braces, to give it side-play or swing if required.

In a third construction, the hind springs are contrived nearly as in the second; but the side springs are fixed to the fore axletree, on blocks with clips or bolts, cross springs being fastened to the bottom of the nunters or futchels with bolts, and the futchels framed into a bed fixed to the bottom of the horizontal wheel.

Whenever it appears requisite, Mr. Elliott fixes braces, ropes, or chains, from convenient parts of one axletree to the other, and from the fore axletree to the splinter-bar.

In the specification reference is made to nine figures of carriages, and their essential parts, according to these constructions; an engraved representation of which may be seen in No. 68 of the Repertory, by those who are desirous to enter more into the minutiæ of Mr. Elliott's methods.

Mr. John Houlditch's *Patent for Improvements in the Construction of four-wheeled Carriages.—Repert. of Arts, &c. No. 69, N. S.*

According to Mr. Houlditch's specification, in every description of crane-necked carriages, instead of connecting the cranes with the wheels in the usual manner, the springs are to be interposed respectively between the axles or other apparatus to which the wheels are usually attached and the cranes. The body of the

carriage is so secured to the said cranes, that it may remain safely and firmly connected in its place as long as may be required; at the same time that it shall be practicable to take off one body and substitute any other, as occasion may require.

Mr. Houlditch makes use of *two* cranes, in preference to any other number, placing them at such a distance asunder that the carriage-body may be effectually supported by them: in some cases he makes these cranes each of two pieces, to be screwed to the body of the carriage without joining each piece together in the middle.

This patentee admits of great variety in the formation of the springs; as, that they may consist either of transverse single bows, with other bows fixed horizontally to their ends and at right angles; or, that the springs may consist each of two bows, joined at the ends, and disposed longitudinally, such as have been commonly applied and known under the denomination of grasshopper springs: he *gives the preference to the latter.* The figures accompanying this specification may be seen in the number of the Repertory mentioned at the head of the present article.

Observations.—Mr. Elliott's patent bears date May 11th, 1805; Mr. Houlditch's March 7th, 1807. The grand peculiarity in each is the omission of the common perch: an omission which is certainly due in the first place to Mr. Elliott. Indeed it would seem that the crane-necked perch is introduced into Mr. Houlditch's contrivances, principally with a view of evading the charge of infringing upon the prior patent-right of Mr. E. How far so slight a modification in the construction may give the later patentee a right, it is not necessary for us to decide, since we conceive it impossible there can be two opinions upon the subject. The reader will perceive, that by means of Mr. Elliott's contrivance, the whole of the carriage rests upon the springs, while no part of the machinery is beneath them but the axles: and is not this all that is effected by the methods proposed by Mr. Houlditch? except indeed we mention the trifling circumstance, that in the latter the same springs may be made to serve for two or more bodies; a circumstance to which, however, Mr. E.'s invention is as easily adapted as Mr. H.'s imitation. Mr. H. likewise proposes to make use of "*grasshopper* springs;" while these have been generally acknowledged to be the contrivance of Mr. E. If all this could be done with impunity, the advantages resulting from patents would become a mere nullity.

To Mr. Elliott, as the real, the original inventor, much commendation is due. He has freed the gentlemen's carriages intended for the metropolis, and for good roads, from a useless incumbrance; and has thereby added much to their gracefulness and elegance, at the same time that he has rendered their motion

more pleasant to those who ride in them, and has materially diminished the labour of the animals which draw them. It is in consequence of the skilful contrivances of such ingenious artists that gentlemen's carriages in this country are unequalled for elegance, ease, and convenience, in any part of the world; and we trust Mr. E. will not be deprived by any servile imitator of the encouragement which ingenuity like his so richly deserves. We may add, that in these remarks we have been solely influenced by a regard to truth and justice; as we are not known to, or have any connexion, either immediate or remote, with Mr. Elliott or with Mr. Houlditch.

Miss Eliz. Bell's *Patent for Improvements in an artificial Method of sweeping Chimnies, and in the preparing and manufacturing Pieces used for constructing the Chimnies, &c.—Repert. of Arts, No. 68, N. S.*

The inventions described in the present specification are meant as improvements upon similar articles described in the specification of Miss Bell's former patent, dated May 10th, 1803, inserted at p. 174, vol. iv. of the New Series of the Repertory. Her method of sweeping chimnies is carried into effect by means of certain apparatus fixed and used at the top and bottom of the flue of any chimney, by means of which a chain or rope can be drawn up and down, being made to carry certain other apparatus, consisting of brushes, or scrapers, &c. to cleanse such chimney.

1st. The apparatus at the top of the chimney consists of a frame of iron, or other suitable materials, composed of two semicircles, admitting of adjustment by means of screws, so as to encompass and adapt themselves to all the various sizes of chimney-pots that are now in use. To these semicircles are attached upright bars, and at the top of these are fixed cross bars with a couple of supports, such cross bars containing the friction-roller, over which the chain or line may be made to pass, while it performs its ascent and descent in the act of cleansing.

2d. The patentee's *lever-brush*, described in her former specification, is now slightly modified. The body or main piece is now made circular instead of square; and the ends of the levers are inserted in the body or main piece, in order to prevent the catching of the seams of the brickwork on the levers. She now, also, makes to each a pair of recurved springs acting against each other; and the point of junction is let into and attached to the main piece by means of a pin or pivot, at the same time so free and loose as to permit the springs to move at their point of junction in any required direction: these springs are furnished at their

lowest extremity with a case or bed to receive the shaft of the lever; the lever above the part furnished with brushes being prevented from receding by a pin. The upper extremity of the lever is let into the block or main piece, by a knee or double joint, which permits it to have such a motion as to act freely in every required direction; that action being regulated by the springs, so as to make the piece expand and contract according as it is pressed upon by the sides of the chimney in its ascent and descent: the middle lever is moved outwards by a circular spring acting from the centre to that part of the lever above the brush. The action of the lever is likewise regulated by cords passing through it nearest the extremity, where the brushes are placed for the purpose of cleansing the chimney; the cords being united in one point of junction, through an eye and friction roller.

3d. An improvement in the elastic sweeper. This is principally an alteration in the exterior figure of this brush, in order to render it capable of assimilating itself to the figure of the various flues intended to be cleansed; for which purpose the sweeper, in its exterior form, must be either a square or parallelogram; and, instead of the springs formerly described, she generally gives it the internal, or, as she calls it, elastic motion by springs of the figure corresponding with its external figure, and to the limbs of the brush; and to those springs she attaches rollers, working in a frame or groove fixed on the pipe or tube that is in the middle of the brush, a flanched socket being properly adapted to the said tube.

4th. An improvement in the apparatus at the bottom of the chimney. This is a wooden frame, which, that it may fit all chimnies, has made in it two, three, or more divisions, that are attached to each other by means of leather, or flexible hinges, folded in the manner of bellows, to render it capable of expanding and contracting. This frame is made not only to cover the opening of the chimney, but to pass over and cover the hearth and grate, being all united by means of the flexible hinges: it is intended to receive the soot which falls during the operation of sweeping, which soot may thus be taken out of the room with the frame or skreen. Connected with this is a portable crane of iron, having such a train of cog-wheels as the power and velocity of performance require. The crane has a double roller or drum, one part of which produces the ascent in the chimney, and the other the descent. This crane may be used on the outside of the frame or curtain placed on the hearth, or any part of the room, without soiling the apartment, the chains in the passage through the curtain being cleansed from soot by brushes and sponge.

Nos. 5, 6, and 7, contain improvements of 5, 6, 7, of the former specification; No. 7 being a rotary sweeper, to which the rotatory motion is communicated by a wheel filled with a

sufficient quantity of cord, which is put upon the chain, and drawn up and down the chimney.

8th. Is an improvement in Miss Bell's former apparatus for extinguishing fire, which consisted in attaching to the chain that passes up the chimney, a vessel of tin, or other material not likely to be broken, and filled with water: this vessel is provided with a valve, or sheet, and slider at its lower part, capable of being opened by pulling a small cord or chain, and thence permitting the water to flow out at any part of the chimney to which the vessel is raised. The patentee now proposes to make this vessel of some flexible material, such as may accommodate its shape, in a certain degree, to that of the flue of the chimney.

Lastly, Miss Bell proposes to construct her chimnies of blocks of pottery, having orifices in them, equal in diameter to that of the intended chimney flue: the present specification contains many directions for the preparation of the clay and the general manufactory of these pots or blocks. But, lest we should exhaust our readers' patience, we refer for these minutiæ to the specification, which occupies 18 pages, in No. 68 of the present series of the Repertory of Arts.

Observations.—We are always pleased to see the attention of the ingenious directed to the alleviation of human misery; and as we believe the sufferings of the chimney-sweep boys are unequalled in any other class of society in this country, we gladly give farther publicity to such attempts as the present. When the contrivances of Miss Bell, Mr. Smart (Trans. Society of Arts, vol. xxiii.), and Mr. Davies (Repertory, vol. iv.), are as well known as they ought to be, there will be no necessity to degrade any part of our species, by devoting them to so odious and destructive an employment.

Mr. Allan Pollock's *Patent for a Stove, on a new Construction, and various Improvements applicable to Stoves, Grates, and Fire-places.—Repertory of Arts, No. 69, New Series.*

The fire-place or grate, in Mr. Pollock's stove, occupies a comparatively small space in the back part of it. This grate is enclosed at the sides and back with fire-stone or brick; and behind this a metallic apparatus is placed for the purpose of heating the external air, as it passes into the room. The apparatus, to which we refer, consists of a case, comprising several shelves, ranged parallel to one another, their ends projecting alternately so as to form a winding passage. That the air may be admitted to move through this winding case, a pipe proceeds to the outward air beneath the floor, and another proceeds from its top,

passing through the middle of the stove, and thence to an ornamental vase at the top of the whole, where ornamental orifices permit its passage into the apartment, it having previously become heated by its transmission through the winding flue, while the interposition of the brick-work, next the fire, has prevented its fitness for respiration from being weakened to any important degree.

There is a hollow column, of about 3 feet in height, rising above the fire-place; and this column is divided into 3 or 4 separate chambers by horizontal plates, the orifices in which, for the transmission of air and smoke, are not posited vertically over each other, but at angles of about 120 degrees; vertical plates being also placed between each pair of the horizontal ones, so that the heated air is compelled to pursue a circuitous course in its ascent, and thus the more effectually to communicate its warmth to every part of the vertical column.

A door is placed in the bottom of the stove, for the convenience of removing the ashes; and therein a register is fixed, by which the supply of air to the fire is regulated. The front of the stove, which is at a considerable distance from the grate, has one or more doors, through which coals are conveyed to the fire: these front openings are furnished with plates of transparent talc, through which the radiant heat may be in good part transmitted.

In order the more effectually to prevent any chemical decomposition from occurring at the inner surface of the pipe of transmission, &c. Mr. Pollock adds such a portion of lime to the sand or loam used in forming his moulds, cones, &c. upon which the metal is to be cast, as shall cause such loam to be to a certain degree fusible, and converted by the action of the heat into a vitreous coating, by which the face of the pipe may be defended against such chemical change.

Mr. Pollock likewise proposes to apply his method of interposing brick or firestone between the fire-place and the metallic flue for heating the air, to other stoves, grates, and fire-places, besides the one described above. Sketches of his contrivances are exhibited in a plate in No. 69 of the Repertory; and one of his new stoves may be seen in use at No. 33, Chancery Lane.

Observations.—We agree with the patentee in the main, as to the advantages derivable from the use of his stoves. Thus, they produce a complete circulation of warm air in every part, free at the same time from those currents of cold air which are usually found so prejudicial in rooms heated in the usual manner. The temperature produced by these stoves is nearly uniform in every part of a moderate sized room heated by them: Fahrenheit's thermometer has been seldom found to indicate a difference of more than one degree in the various parts of such room; whereas,

in apartments heated in the usual manner, a difference of from 5 to 10 degrees is often found to subsist, and that within 6 feet of the fire-place. The lining the part of the stove, wherein the fuel is placed, with brick, prevents the surfaces of the stove from being overheated; and thus renders them secure from the danger of setting the edifice on fire. The patentee has paid a judicious regard to one of our old English prejudices, by giving us *a sight of the fire* through the transparent substance, of which part of the stove-front is constituted: we hope he will attend to this still farther; for we conceive that the ornamental appearance of the stove, as well as its more gratifying effect, will be augmented by increasing the size of the glazed orifices or doors.

It is our duty, however, to remark, that the general contrivance proposed in this stove for heating the air, though certainly economical, so far as it regards the saving of fuel, is not new, being the same as that described several years ago by Dr. Franklin, under the title of the Philadelphia stove. We have also some doubts how far the surface of the tubes will become sufficiently coated and polished, by the means Mr. Pollock proposes. But we still think his contrivances altogether ingenious, and hope they will experience a fair trial.

Messrs. W. *and* E. W. Chapman's *Patent for Methods of making a Belt or flat Band, for raising heavy Articles in any Situation whatever.—Repertory of Arts, No.* 68, *N. S.*

The peculiarities of Messrs. Chapman's inventions are stated to consist, first, in the combination of two or any greater number of strands of shroud-laid rope, side by side, so as to form any determinate breadth of belt or flat band; and, secondly, in the machinery for facilitating its formation. A strand of a shroud-laid rope is the first combination of the yarns, which are twisted together round one common axis, so as to form a compact cylindric mass; and the common shroud-laid rope is formed of three of these strands, twisted together the contrary way to the twist of the strand; which is necessary for common purposes, although the loss of strength is so considerable, that, in the opinion of the patentees, exclusive of the reduction of length from being made into a rope, the strength of two strands made in such a way as to cause all the yarns to bear an equal tension, or nearly so, will, when laid side by side, be nearly equal to that of three such strands combined in a rope.

The specification describes various methods of connecting the strands laterally, so as to procure this decided advantage. In the principal method, the strands are stitched together side by side, by means of an apparatus in which two strong needles are forced

obliquely through them from opposite sides, either by screws turned by a winch, or by revolving nuts; while they are hindered from turning by projecting pieces of iron, that slide in grooves properly adapted for the purpose.

The needles, screws, &c. are attached to a frame, made somewhat like a strong table and placed on four wheels. There is likewise a *belt-board*, which is formed of elm or other suitable substance; in the middle of which there must be a groove of proper width to admit the designed number of strands to lie side by side; as well as of a suitable depth to retain them in their places. The strands must all be equally stretched, which is effected by attaching to each of them, whilst they are laid in the rope-ground, a rope, on which equal weights may be suspended by means of leading pullies. The strands being thus stretched, one, or any convenient number of trucks, with their apparatus, may be placed under them, so as to expedite their being stitched together, as above described. If the rivetting the strands by strong wire or rivet pin be deemed eligible, the pins may be forced through, by having two side screws, placed upon the truck directly opposite to each other, and pointing in the same line.

Instead of needles, piercers may be used, and the tapered ends of the stitching lines be put through. The hauling forward of the truck or table any determinate space between each stitch, may be done by means of a winding barrel on the sledge, and a chain or rope leading from it to any fixed object. But if the operator prefer drawing forward the belt or flat band, as it is stitched, then the truck or frame may be stationary and without wheels. The patentees, however, give preference to the former method of progressive transition in the machine itself.

Observations.—We cannot say much in favour of the *novelty* of the principle on which Messrs. Chapman found their patent. Every body who has paid any attention to the nature of rope-making is aware, that by twisting the fibres we diminish their actual strength, to overcome external resistance. It is well known that a skein of fibres may be twisted so very hard, that it will break with any attempt to twist it harder: all the fibres are then strained to the utmost, and, with reference to *utility*, may be said to have *no strength*; the skein can carry *no* weight. What is said of this extreme case, may be applied *cæteris paribus* to every other. The strength of any twisted skein is the remainder of the absolute strength of the constituent fibres after we have deducted the force employed in twisting them together. From these considerations was deduced the grand practical maxim so long acknowledged in rope-making, namely, that all twisting beyond what is necessary to prevent the fibres from being drawn out without breaking, diminishes the strength of cordage, and should

always be avoided when it is possible. Indeed a *parallel* distribution of the fibres, when attainable, has been constantly acknowledged to be best: and nothing is better known to a mariner than the superior strength of rope-yarns, made up into a skein *without twisting*; forming a piece of rope they call *salvage*. So well is the depreciating effect of twisting understood, that it has long been laid down as a rule, that the strength of a rope is to the united absolute strength of its yarns, as the length of the cord to the original length of the yarns. These deductions do not rest upon theoretical considerations merely: Du Hamel, Sir Charles Knowles, Réaumur, and others, have submitted the matter to the test of experiment; and as Réaumur especially has entered more into minutiæ than the present patentees seem aware of, we will transcribe a few of his results from the *Memoirs of the Paris Academy*, for 1711.

1. A thread, consisting of 832 fibres of silk, each of which carried at a medium 1 dram and 18 grains, would hardly support 5½lbs. and sometimes broke with 5lbs. The aggregate strength of the untwisted fibres was more than 8lbs. 2oz.

2. A skein of white thread was examined in many places. Every part of it bore 9½lbs., but none of it would bear 10. When twisted slack into a cord of two yarns, it broke with 16lbs.

3. Three threads were twisted together, the mean strength of each of them being 8lbs. The cord broke with 17½lbs. whereas it should have carried 24.

4. Four threads, the mean strength of each being 7½, broke, when twisted, with 21½, instead of 30. Four others, whose individual strength sustained 9lbs. broke with 22, instead of 36.

5. A small and very well made hempen cord required from 60 to 72lbs. to break it in different places. Another part of it was separated into its three strands: one of them bore 29½, another 33½, the third 35; so that the sum of their absolute strengths was 98.

In Admiral Knowles's experiments, each of the 72 yarns of an untarred cord carried 90lbs. while the rope formed from them would no where sustain more than 4552 pounds, instead of 90 times 72, or 6480.

It is evident, then, from this induction of particulars, that the idea of the constituent fibres being weakened by the operation of twisting is far from new: and farther, Messrs. Chapman are not the first who have thought of *flat ropes*; for, in 1798, Mr. John Curr, of Sheffield, obtained a patent for making a flat rope of smaller ones sewed together (see Rep. of Arts, vol. x. p. 361, of the first series) in the same manner as now proposed. There is, it is true, a difference in the apparatus; the former patentee using levers to force the needles forward, instead of the screws now recommended; yet we must be free to confess that in our opinions Messrs. Chapman's specification contains no essentially new invention.

For a little more on the subject of cordage, especially as compared with chains, the reader may consult p. 169, of our second volume, where we made some remarks upon Mr. Gilpin's improved crane, to be used with chains.

Mr. William Speer's *Patent for purifying, refining, and otherwise improving Fish Oils, and other Oils; and converting and applying to Use the unrefined Parts thereof.—Repertory of Arts, No. 69, New Series.*

This invention consists in adding a solution or infusion of some substance, which contains tannin, as the barks of oak, alder, chesnut, birch, willow, elm, or the root of tormentil, or of sumach, nutgalls, or Japan earth, or artificial tannin, or any other substance that will coagulate a solution of animal glue or gelatine: among which oak bark seems the most economical.

To refine the common whale or seal oil, a quantity of soft water is to be taken, in which is to be infused, for some days, about a tenth of its weight of oak bark, chopped or ground small. The mixture being frequently shaken up, is at last to be racked off clear into another vessel. Then the oil and infusion is to be poured, in equal quantities, into a copper boiler, and made to boil, and is to be continually agitated by a churnstaff, or agitator, for some time. When the mixture has boiled a quarter of an hour, a quantity of cold water, capable of considerably lowering the temperature, may be poured in gradually, and the boiling and agitation continued for another quarter of an hour. The mixture is then to be run off into a vessel to settle, after which the oil is to be racked off. If the oil be not sufficiently clear, the process must be repeated.

And for the further purification of the oil, it should, after it is separated from the grounds, be again agitated in warm water, or a weak infusion of tannin.

For other oils, the quantity of oak bark, or other substance to be used, and that of the water, must be varied according to circumstances; as also the degree of heat, and time of agitation.

The grounds, thus procured, may be used in different ways; 1°, Mixed with lime, or gypsum, and thus to form a plaster, or stucco. 2, Mixed with proper colouring, and other matters to make paints and varnishes. 3°, Made into putty, by adding the usual ingredients, except linseed oil. 4°, Or employed as an ingredient in the making of blacking for leather, towards rendering the same capable of resisting water.

Observations.—The process here mentioned can scarcely be used, except for animal oils, which are loaded with gelatine, as

the mucilage that adheres to vegetable oils is not precipitated by tannin. But as acetate (Goulard's extract) of lead, and superacetate (sugar) of lead coagulate with most of the vegetable mucilages, they might be used for this purpose, if any addition is thought necessary. But it is well known that it is sufficient to agitate the oil along with warm water, especially if some sand is added in order to mechanically divide the oil and thus increase the contact between the fluids, as both the gelatine and mucilage have a much stronger attraction for water than for oil.

Mr. Joseph Astley's Patent for Improvements in the Manufacture of Sal Ammoniac.—Repertory of Arts, No. 70, New Series.

This improvement consists in employing muriate of magnesia, procured from the bittern of the salt-pans, and in impregnating animal substances with that salt. These substances are to be afterwards dried, on a heated floor or otherwise, and then either distilled in close vessels, or burned in a kiln, so constructed that the products of the combustion may be collected in chambers or receivers, which have, at the same time, a sufficient vent to maintain the necessary current of air.

In lieu of the muriate of magnesia, any other of the combinations of muriatic acid from which the acid can be disengaged by heat, may be employed. And, in like manner, any vegetable substance that affords ammonia by distillation, may be employed instead of animal substances The salt may also be employed in a dry state, and merely mixed with the other substances. Or substances of any description whatever, provided there be nothing in their nature rendering them chemically or mechanically unfit to serve as vehicles for such purpose, may be impregnated with the muriatic salt, and then treated along with the animal or other substance.

This mode of effecting the decomposition of these muriatic salts, is not attended with the same inconveniencies as their distillation per se.

The drying of the substances previous to distillation, may in some cases be dispensed with, but will generally be found expedient.

Observations.—In vol. i. p. 16, we have given some remarks on the effects produced by the interference of the excise on the manufacture of sal ammoniac. Although sulphate of soda is not produced in this process, yet the use of the bittern of salt-pans might probably instigate the officers to extend their visits to these manufactories, and thus oblige them to give up their work. The process is certainly well contrived; but we do not apprehend that

the attraction of the acid for the ammonia will have any effect in facilitating the decomposition of the muriate, as the gaseous form of ammonia will quickly remove it from the muriate; so that the sal ammoniac is, we apprehend, of secondary formation in the receiving vessels.

Mr. JOHN WILLIAMS's *Patent for a new Mode of covering and enclosing all Kinds of Carriages.—Repertory of Arts, No. 70, N. S.*

MR. Williams constructs a moveable frame or cover, capable of being disposed between grooves, or within a cell in the body of the carriage, and of being drawn up by straps, or webs, that act nearly in the manner commonly adopted with regard to the glasses or blinds of carriages. When it is requisite, windows or apertures are put in these frames or covers; and when the materials thereof are inflexible, they are made of a spherical, spheroidal, or cylindrical figure, or of such other description as shall, in its own nature, be referable to an axis. The frame or cover is made of any desired magnitude, and with ends or sides, so as to cover either part or the whole of the carriage: and by means of stops, pins, or holes in the straps, it is contrived that the cover may be drawn out of its cells or receptacles, in greater or less portions, as may be proposed. Sometimes, instead of making the covers of inflexible materials, this patentee makes them of small bars of wood or of metal, joined together sidewise, either by sewing or gluing them to a cloth or to each other, as is sometimes done in the covers of writing tables, &c. And when this method is adopted, it is not necessary that the cells or receptacles in the carriage should have a figure referable to an axis; a great variety of form being then admissible.

Sometimes cloth, or some equally flexible material, is chosen. But in every case, wherein the said cover shall be made of substances more or less flexible, it is necessary that certain leaders or supports should be provided, by which the covers may be held in their place when in use.

Mr. JOHN PHILLIPS's *Patent for Improvements in the Construction of Tinderboxes, &c.—Repertory of Arts, No. 70, N. S.*

MR. Phillips has converted the tinderbox into a compound apparatus, which makes it serve at once for *tinderbox*, *lamp*, or *candlestick*, *lantern*, and *dumb-nurse* and *water-candlestick*. The tinderbox itself serves for the pedestal, on which the other part of the apparatus rests; and it may be circular, square, hexa-

gonal, or of any other proposed form. The steel of the tinderbox is fixed to the middle of the damper. A cap is made to fit properly over the tinderbox, and this cap has fixed to it, two, three, or four vertical wires, of sufficient strength to bear a lantern, or transparent skreen of glass, or other suitable substance, by means of hollow cylinders, in its frame, which may be adapted to the wires, so as not to slide up and down them too freely. This skreen may, when necessary, be fastened at any assigned height, by means of a nut and screw, which may be pressed upon one of the vertical wires. The socket, which carries the candle or lamp, is fixed to the top or cap of the tinderbox, while it slides freely through the bottom of the lantern or skreen; and is susceptible of such adjustment, by means of water, that a candle in it will burn and furnish a proper light, till nothing but the snuff or wick remains. The upper part of this apparatus is nearly the same as the upper part of a common lantern, except that the cap has a joint on one side and a button and loop on the opposite; by means of which, it may be either fastened on or thrown back, so as to leave the lantern open at top, for the reception of a panada saucepan, or other vessel, for the purpose of being heated by the candle or lamp, while it continues to transmit light into the room through the glass or horn skreen. Air may be admitted into the lantern by orifices in its bottom, more or fewer of which may be opened at pleasure, by a rotatory plate: and, when it is thought proper, two hollow transparent skreens may be fitted one within another, the interval between them being filled with water, spirits of wine, or other transparent liquid, through which the light will be steadily and equally diffused. When the lantern is angular, mirrors may be advantageously placed therein, so that it may serve for gigs, chaises, &c. in the night.

Observations.—The contrivances, for which Mr. Phillips has taken out this patent, are ingenious and deserve encouragement. The idea of combining a tinderbox with a lamp or lantern is, we believe, quite new, and certainly entitled to some commendation; but we think Mr. Phillips would have done as well, had he accommodated his contrivances to what is called the *German tinderbox*, with amadou and some phosphoric preparation, rather than to the common tinderbox, the use of which is, in our estimation, never pleasant in the night. The apparatus, however, as it now stands, will be found safe and useful in shops, nurseries, stables, ship-cabins, &c. as it supplies at the same time a fireguard candlestick or lantern, a flame to heat cordials or other liquids, and a tinderbox to obtain fresh light when the former is extinguished.

Mr. William Chapman's Patent for Methods of reducing the Wear, and prolonging the Duration of Ropes used in drawing Coals, &c. from Pits or Shafts of Mines.—Rep. of Arts, No. 70, N. S.

In the deep coal-mines of Northumberland and Durham, baskets of about 8 cwt. of coals are frequently drawn up with a mean velocity exceeding 10 feet per second; and the lifting of the coals and baskets is almost instantaneous: the shock is, therefore, considerable in starting the loaded basket or corf; and it is great also when the loaded corf happens to strike underneath the light one, which, on account of its size, and the requisite quantity of iron in it, generally weighs near 2 cwt.: so that, as they approach each other with a velocity often exceeding 20 feet per second, the shocks thus mutually communicated by the baskets shorten the duration of the ropes.

Mr. Chapman's methods of remedying the evil are independent of each other, and may be used either together or separately. They are simply these: first, the reducing of the shock arising from suddenly putting the loaded basket in motion, and diminishing the effect of any other shocks which may be received during the ascent or descent of the full or empty vessels; and secondly, in causing the rope to wear more equally throughout from end to end, and preventing its fibres from being torn by the rope being kept in full stretch round the winding-barrel.

In the first case, Mr. Chapman causes the pullies, over which the rope passes immediately above the pit, or any pulley in the approach to it, to recede and slacken out the rope on its receiving increased tension, and to return when the tension is lessened. If pullies in the approach be used, then those over the pit may be stationary, as they are at present, and the moving pulley may progressively lift or lower a series of weights, the whole of them a little exceeding the greatest gravitating resistance. Where the pullies suspending the ropes over the pits are made to descend or ascend according to circumstances, they may be suspended from, or sustained upon, any thing elastic, either of metal or wood; or they may be counterpoised by a weight on a spiral, or by a series of weights capable of resisting the varying pressure on the pulley, and of receding on receiving a sudden impulse, so as to divide and reduce the effect of the shock; or the springs and weights may be combined.

Another method of reducing the sudden shock on the ropes, and which may either be used separately or combined with the preceding, is to give motion to the rope-wheel, or barrel, by the intervention of strong springs, either by the axis being in two parts connected by springs and a coupling bar, or by the barrel turning upon an axis, and being held by springs fixed to it, which

on any sudden shock will suffer the wheel immediately to have its motion retarded, or to move through a less arc of rotation than the axis which follows the uniform motion of the engine.

Mr. Chapman's method of causing ropes to wear more equally throughout, when employed in raising minerals, &c. up a shaft, where they are drawn over a pulley, differs from the ordinary method, in which two separate ropes, attached to the rope-barrel, pass each of them over a pulley, one winding upon the rope-barrel, whilst the other is winding from it: instead of this Mr. C. passes the two ends of the same rope each over its separate pulley, so that one end is at the top whilst the other is at the bottom of the pit; and the loop of the rope, going to and from the pit over the two pullies, is passed over a grooved wheel, or round a rope-barrel, so that, when at work, no part of the rope is stationary on the barrel.

The rope or chain which lifts a series of weights, or one weight with the intervention of a spiral, may be attached to a barrel, connected with a loaded lever on the same axis; in which case, the stress on the chain or rope would be increased or diminished according as the lever became more horizontal or vertical during the motion of the sheave, which should generally be limited to less than a quarter of a circle. And the purpose of producing a diversity of resistance on the pit-ropes, with uniformity of counterbalancing weight, may be accomplished by placing the two wheels or pullies, whose centres are in the same horizontal line, at a distance from each other, greater than the diameter of the pulley hanging down between them, on which the weight is suspended; for, by this contrivance, the two parts of the rope which passes over the rising pulley, will pull more and more obliquely as the latter approaches the horizontal level of the other two.

Observations.—Mr. Chapman has illustrated the different methods proposed in his specification, by diagrams, engravings of which are given in the Repertory. We think some of these contrivances simple and ingenious, and have no doubt that they will be found of utility.

Mr. Michael Logan's *Patent for a System of Marine, Fort, and Field Artillery.—Repertory of Arts, No. 69, N. S.*

The system now proposed is directed to the following objects: first, the cannon or gun carriage is reduced, by construction, to occupy the least possible space, and consequently to present the least surface to the action of either the direct, oblique, or flank fire of the enemy. Secondly, for the security of the gun-carriage

in the time of action, when employed for sea-service on board of line of battle ships, or other ships of war, or as marine or fort artillery, it is covered from the fire of the enemy by the gun and fulcrum, and is, by construction, rendered permanent, and always true to the centre of the port or embrasure. Thirdly, the recoil or reaction of either light or heavy cannon is, by the operation of this system, completely performed within the carriage itself, and can be diminished or increased at pleasure. Fourthly, the horizontal range, and the elevation or depression of cannon in the time of action, is correctly performed with a uniform motion, and with the greatest facility and security to those employed in the operations of this artillery. Fifthly, the cannon or gun carriage contains in itself, by the geometrical design of its construction, the least quantity of materials of which it can be made, and the strongest fortification against the effect of either shot or shells.

Mr. Logan's system of construction comprises the following parts; that is to say: First, the body of the gun-carriage; which may be made of wood, iron, composition of metal, or other fit material. Secondly, the fulcrum: which Mr. Logan makes either of cast-iron, or composition; and which supports the piece of ordnance by its trunnions upon the carriage, either by a single cylinder, or by two parallel cylinders, in an horizontal position, upon iron axles. Thirdly, the train bar and cylinder, with the gun-screws and bed of the cascable, which in time of action elevate or depress the breech of the cannon. Fourthly, the recoil-chain, with its fore-roller, chain, staple, and but-pinion, fixed on iron axles in the front and but of the carriage. Fifthly, the bolster or head-bearing, and the legs which are united in construction, by the tie or span-iron, parallel to the base of the carriage. Sixthly, the centre-pin and fore-staple, which is fixed by strong bolts to the lower sill of the port or embrasure. Seventhly, the train-post and swifter, by which one man only is enabled to give the heaviest artillery, or piece of ordnance, its horizontal range, with a steady uniform motion, and to sustain it with the greatest ease, in any assigned position, either upon the deck of a line of battle ship, or on the platform of a battery, in the time of action.

Observations.—Such, according to Mr. Logan, are the maxims and general nature of his construction, which he proceeds to exemplify, by describing the carriage, &c. to a 32 pounder, 10 feet, 7 inches, 4 lines, in length; and weighing 6328lbs. avoirdupois. As the subject of artillery, always important, is especially so in the present eventful period, we turned to this specification with avidity, and perused it with attention; but unfortunately, either it is too obscure, or our perception is too obtuse,

for us to comprehend it as we could wish. The patentee sometimes makes use of technical words, of which we have never heard, and at others applies old terms in a new sense; so that it is often next to impossible to divine his meaning; and, to augment the obscurity which, on these accounts, pervades the specification, the patentee has not furnished us with the kind aid of a single diagram. This mode of procedure is against all precedent. *Muller*, and all the best authors on artillery, English and foreign (with the exception of such little manuals as the *Gunner's Guide*, &c.), are so cautious to guard their readers against misapprehension, that they commonly give a profusion of engravings; and do not even describe a gin, a truck carriage, a sling, or a devil-cart, simple as they are compared with a gun-carriage, without presenting a plan and an elevation. We regret much that Mr. Logan, by reason of this neglect, places it entirely out of our power to speak of the merits or demerits of his invention. For Mr. R. Friend's improvements in gun-carriages, we refer the reader to No. 61 of the New Series of the Repertory of Arts; or p. 218, vol. iii. (No. 9) of this Retrospect.

CHEMISTRY AND MINERALOGY.

Report on the sprinkling of Malt on the Floor. By Mr. John Carr.—*Repertory of Arts, Second Series, No.* 68.

The commissioners of excise have recommended this Report to the lords of the treasury, as perfectly conclusive on the subject; and as the result of much experience in surveying the making of malt in many parts of the kingdom.

The two different modes of watering, and not watering, the corn upon the floors appear each of them to be supported by practical facts, for want of tracing the causes up to their true source. Mr. Reynoldson, one of the agents of the watering party, is the only person who has pretended to discuss the matter scientifically. His account, however, is very confused, and there are several symptoms of his leaning with no inconsiderable bias to his own side of the question. He has, however, allowed that a judicious limitation of the restrictions against watering on the floors would increase the value of malt ten per cent.; and he declares his belief that malting and brewing are yet in a state of infancy. The appearance of scientific research in Mr. Reynoldson's evidence appears to have made an impression upon the committee of the House of Commons, to whom the several petitions relative to the making of malt were referred.

As a correct knowledge of that part of the process of malting wherein nature is principally employed is the foundation of all

reasoning upon the subject, it will be necessary to state what is probably the true theory of malting.

The barley grain consists of the germ comprising both the plumula (acrospire) and the radicle; and of a portion of farinaceous matter, intended to be converted into saccharine matter by germination. When the grain is made moist and warm, it imbibes the heat and moisture, and swells greatly. The radicle is most susceptible of this enlargement, and also attracts the oxygen of the atmosphere, which, after depositing heat on entering into combination with the farinaceous substance of the grain, converts this substance into saccharine matter. The radicle soon pierces the husk of the grain, and throws out fibres that elongate downwards. At the same time the acrospire, invigorated by the heat produced from the combination of the oxygen, slowly advances through the body of the grain, and piercing the opposite end, shoots up into a green blade, leaving the empty husk behind it.

The most important part in the manipulation of malting consists in the nice adjustment and due regulation of the heat generated in the process. And as the formation of saccharine matter is progressive, and the grain is ulteriorly totally deprived of it, it is necessary to seize the proper time to stop the germination of the corn, by throwing it upon the kiln, in order to procure the greatest proportion of saccharine matter.

Mr. Reynoldson asserts, that the saccharine matter exists ready formed in the barley, and that malting only developes it; but this is so contrary to the fact as not to require any refutation.

Malting, therefore, is only the promotion of a healthy germination of barley up to that period when the largest proportion of saccharine matter has been formed. As in every natural process a variation of the means will necessarily cause a difference in the product, the great difference in the process, when watering is used, or not, must render the quality of the malt in one case superior to the other.

If grain throws out too much root, the substance will be exhausted, and the malt light and unproductive. Hence the process which fully malts the barley with the least possible root is the best, and it is well known that the Hertfordshire method of not watering the corn on the floor produces only a short and small radicle. The other method of watering the corn throws out a much larger root, which being afterwards burnt off on the kiln, becomes mere waste, and is the cause why malt, forced as it were by watering, is lighter and less productive than when made by the Hertfordshire method.

Maltsters commonly suppose that the grain becomes malted just so far as the acrospire penetrates the grain, and that the unpenetrated part remains barley; but the evidence of Messrs. King and Clough sufficiently established that the best malt is made when the acrospire proceeds only two thirds through the grain. In

fact, the radicle is the efficient organ in malting the barley, while the acrospire simply feeds on it; so that in the Hertfordshire method, where the corn is constantly kept cool, the growth of the acrospire is sufficiently slow and gradual to allow the radicle to malt the whole substance of the grain, though the acrospire has not proceeded all through the barley: whereas, in forcing the grain by watering it, the acrospire is driven rapidly forward, and being insoluble in the process of brewing, it contributes to waste the malt.

Malt made by watering weighs from 15 to 20 pounds in four bushels less than an equal measure of malt that has not been watered. And watered malt affords only 64 pounds of extract, while unwatered malt yielded 84 pounds from the same quantity.

An excess and fluctuation of heat are certainly highly injurious to the regular progress of vegetation. When there is no increase of moisture after the corn leaves the cistern, an equable temperature can be preserved with much certainty; but when the floors are watered, this equable temperature cannot be kept up, an unequal vegetation takes place, the moisture is evaporated, and the heat again renders water indispensable.

This heat, improperly rising to excess in the young floors, is the true cause of what is termed flinty malt. The flint consists of little hard knobs in the grain, which are insoluble. The heat occasions the glutinous mucilage of the barley to run into a clammy substance, somewhat like birdlime, which hardens on the kiln.

As the agents of the watering party deny their process to be the cause of flint, so do they assert that they can make malt of superior flavour by sprinkling the grain; but certainly that malt which is worked in the most pure, clean, and natural manner, will be the most free from any adventitious flavour. In watering on the floors the grain is turned immediately after it has been sprinkled; hence the wet corn is placed at the bottom, and some of this will again be thrown undermost in the subsequent turnings, and become mouldy. The disgusting taste of these grains infects all those in contact with them, and materially affects the flavour of the beer.

To mix the coarsest and heaviest barleys with the very finest, in the same cistern, would certainly be improper. It appears, indeed, that thick-skinned corn requires to remain a few hours longer in the cistern; but Messrs. Clough and King have fully established, that better malt can be made from coarse barley without watering it, than by sprinkling it. The agents of the watering party are equally mistaken in asserting, that although the plump barleys of the south may be malted without being watered, the inferior corn from the north requires sprinkling. But it is well known that the inferior barleys are apt to run themselves out by too quick a vegetation, and yet they cannot, from

their lightness, allow any part of their substance to be lost in the process of malting.

There are only three varieties of malt, viz. brown, amber, and pale malt. The two first are peculiar to porter brewing, to communicate flavour and colour. The third is the basis of porter, and all other malt liquor. Brown malt is made on the kiln, by what is called blowing. It is spread very thin, and a quick heat is passed through it from blazing faggots, which blows up the husk, and renders the grains large and hollow, with an increase of measure, of one or two bushels in a quarter. The use of this malt is rapidly declining. Amber malt is a variety between brown and pale malt, and is made by giving it less fire than the former, and more than the latter. It is still generally used in porter along with pale malt, but the quantity made is inconsiderable.

If the vegetation of the grain has been imperfect, the product will be partly malt and partly barley, and of course heavier than good malt. If the vegetation has been carried too far, much of the substance of the malt will be driven out, and the malt will be proportionally light. This is so well known in the markets, that the buyers of malt usually govern themselves, as to the price, by the weight which a certain measure of the sample yields. In this respect, Hertfordshire malt preserves a distinguished superiority over watered malt.

There are no frauds of any extent practicable at a malthouse, except those which are immediately connected with the practice of watering the corn on the floors. A cautious and artful maltster may defraud the revenue of half the duty which he ought to pay, and yet incur very little risk of detection, provided he is indulged with watering the short wet corn on the floors.

The revenue upon malt can only be protected from very extensive depredation, and the quality of the commodity preserved from a most improvident waste, by the restriction against watering on the floors being extended from its present period of nine to twelve days, for a very material circumstance was overlooked when the present restriction was established, viz. that when short wet corn is fraudulently laid upon the floors, it does not take the true age of its being removed from the cistern, but a false age of the date of the preceding steeping, either from its being mixed with the youngest floor, or passing for it in the officer's account. In this way three days of false age can be readily gained, and the corn watered on the seventh instead of the tenth day. But on the old restriction of twelve days, the short wet corn could not be worked up to that period without watering it, by which the penalty was risked, and the officer's attention excited.

This statement of the theory of malting was confirmed by visiting all the principal malthouses in England, and conversing with the oldest labourers as well as with their masters.

In Hertfordshire, and in the northern direction from London, where malt is made without watering, 115 malthouses were visited. The corn was usually kept under water, from 48 to 56 hours, according to the weather. When thrown out of the cistern, it remains in the couch from 26 to 30 hours, and it is kept for a day longer at a depth of 10 to 16 inches. The increase of temperature is carefully watched, and checked by turning the grain. By the fourth day, the root has come freely out, and the corn is spread very thin, so that the temperature is but a little above that of the air. It is worked in this manner up to the 8th or 9th day. The root in the mean while turns back, and forms a little bushy knot of fibres, which rarely exceeds half an inch in length. To promote the growth of the acrospire, the grain is then laid a little deeper, and so gradually increased up to the kiln, when the acrospire has reached two thirds, or at most three fourths up the grain. The old floors were fresh, sound, and in healthy vegetation; even where the grain had been some time on the kiln, the moisture flying off in a dense vapour shewed that the barley had carried with it from the cistern a sufficiency of water for the purpose of completely malting it. The malthouses were kept remarkably open, and yet the cistern water was not expended by evaporation. The coolness of the floors was avowedly to prevent the corn from sweating out the cistern water, and to keep back the vegetation.

The brewers, some of whom were also maltsters, asserted that they could draw upwards of half a barrel more wort, of equal goodness, from a quarter of unwatered malt than from watered. The usual quantity was $3\frac{1}{2}$ barrels to a quarter of malt. Scarce any of the porter malts were in preparation.

About 60 malthouses were visited in Surrey and the country west of London, where the corn is usually watered on the floors. For the first three days after the barley is thrown out of the cistern, it is kept 16 or 18 inches deep, and sweats very much, throwing out a long root. It is then spread out very thin, to carry off the remainder of the cistern water by evaporation, which checks the vegetation, so that on the 9th day the root is frequently flaccid and brown. As soon as the nine days of restriction are expired, the corn is watered, at three separate sprinklings, turning over the corn each time, and leaving it undisturbed from 12 to 18 hours. In some cases, the operation is repeated. A second root is thus thrown out, by the side of the old one, which last is purposely beat off in turning. This new root increases the measure of the malt, and with the same view the acrospire is frequently driven much beyond the end of the grain; but the length of the acrospire was very various. In many floors the corn was run together in hard bunchy knots, by the fibres of the roots matting together. Many also of the floors were mouldy, or, as they term it, finnery. The malthouses were much larger than those in Hertfordshire, but kept much closer, which is no doubt

one of the causes of the malt becoming mouldy. The use of watering is held to be an increase of measure, which in one instance was said to be two bushels in twenty. The brewers, and a maltster who made chiefly for a considerable brewery, made their malt without watering it.

At many of these houses the frauds of short wetting had been extensively practised, and these frauds are evidently still considered as a source of very productive emolument annexed to the watering system. Notwithstanding the preference given to Hertfordshire malt, they urge no complaint on that head, but assert they are greatly injured by what is called ship malt on the coast, which is sold at an inferior price, which they allow can only arise from fraud and watering: admitting also that their own frauds have been suppressed, while the others are going on.

Observations.—The superiority of the Hertfordshire malt, made without wetting, is so well established, that there can no longer exist any doubt, but that the watering system is merely kept up for the sake of a double fraud; first, of defrauding the revenue; and secondly, of deceiving the purchaser, by the sale of a very inferior article at a somewhat lower price than the best goods, but still beyond its intrinsic value.

The miserable attempt of some persons to blind the eyes of the Committee, by the use of a scientific jargon combined with a false statement of facts, affords a melancholy instance of the shifts to which artful and interested men, however respectable in other things, resort, in order to cover their frauds on the revenue.

Analysis of the Waters of the Dead Sea, and of the River Jordan. By Dr. Alexander Marcet.—*Phil. Trans.* 1807, *Part II.*

The Dead Sea derives its name from its intense saltness, which prevents either animals or vegetables from living in it. Although this circumstance has been mentioned by many very ancient authors, the only chemical analysis of its waters is that by Macquer, Lavoisier, and Sage, published in the Mem. de l'Acad. des Sciences for 1778, which is very imperfect.

Mr. Gordon of Clunie, recently brought from the Dead Sea a phial containing about $1\frac{1}{2}$ oz. from a part of the lake about two miles from the mouth of the Jordan: and another somewhat larger phial of the water of the Jordan. This specimen was brought from a spot about three miles from where the river enters the Dead Sea.

The specific gravity of the water of the Dead Sea is 1·211, so that it has been found that a man may lie motionless in any attitude on its surface, without danger of sinking. It is perfectly

transparent, and does not deposit any crystals in close vessels. Its taste is peculiarly bitter, saline, and pungent. It forms copious precipitations in solutions of silver. Oxalic acid throws down oxalate of lime, and this being separated, both caustic and carbonated alkalies readily throw down a magnesian precipitate. Solutions of barytes produce a cloud, which shews the presence of sulphuric acid. Succinate of ammonia does not detect any alumine in it; nor are the infusions of litmus, violet, or turmeric altered in colour. It will take up more common salt.

From hence the water appears to contain the muriates of soda, lime, and magnesia, along with sulphate of lime. The composition, therefore, of these salts was examined.

A known measure of muriatic acid was poured upon marble, which had been previously ascertained to contain 56·1 per cent. of lime. The undissolved marble being weighed, and the solution evaporated to dryness, and ignited, the muriate of lime was found to contain 50·77 per cent. of lime, and 49·23 of acid.

A certain measure of muriatic acid sufficient to dissolve a known weight of marble, was added to calcined magnesia, and the excess of acid saturated with marble; and from thence muriate of magnesia, perfectly free from water, was found to contain 43·99 per cent. of magnesia, and 56·01 of acid.

A certain measure of muriatic acid sufficient to dissolve a known weight of marble, was treated with nitrate of silver; and from thence the luna cornea, after being melted, and heated to redness, was found to contain 80·95 per cent. of oxide of silver, and 19·05 of acid. Then nitrate of silver being precipitated by a known weight of common salt, it was found to contain 46 per cent. of acid, and 54 of soda.

In order to estimate the defects and advantages of the different methods which might be adopted for the analysis of the water, they were tried on artificial solutions, containing the three muriates found in the water, but omitting the sulphate of lime.

The first solution was evaporated to dryness, and ignited for an hour in a platina crucible, pretty closely covered. The residuum was elixiviated with water to separate the magnesia, the lime was precipitated from the ley by carbonate of ammonia, and the common salt obtained by a new evaporation. But the muriate of magnesia was not completely decomposed by the ignition, and therefore this mode of analysis indicates less magnesia, and more lime, than was really in the solution; the estimate of common salt was tolerably accurate.

The lime of the second solution was precipitated by oxalate of ammonia, the muriate of magnesia was decomposed by heat in an open crucible, and the common salt was obtained by elixiviation and evaporation; the estimate of lime and magnesia was accurate, but the common salt was materially reduced by the heat necessary to decompose the muriate of magnesia.

In a third solution, the lime was precipitated by oxalate of am-

monia, the magnesia by recent carbonate of ammonia, and the common salt obtained by evaporation and desiccation. But the magnesia was only imperfectly precipitated.

The most successful method was to separate the muriatic acid from part of the solution by nitrate of silver. From another portion the lime was precipitated by oxalate of ammonia, and the magnesia either by caustic potash, or by carbonate of ammonia; in which latter case the precipitation is imperfect, and the remainder of the magnesia must be separated by exsiccation, ignition, and subsequent elixiviation. The quantity of common salt was inferred from the remaining quantity of acid, after the portions of acid belonging to the other two muriates had been calculated. This estimate may be corrected by actually obtaining the common salt from one of the portions of the solution. This method was found to be remarkably accurate.

The information thus acquired, was applied to the analysis of the water of the Dead Sea.

Twenty grains of this water, being evaporated at a heat of about 180° Fahr. left 8·2 gr. of an opake white mass, containing crystals of common salt. This mass deliquesced in the air, and being again dried at 212 Fahr. left 7·7 gr. This residuum being exposed for a few minutes to a heat about 15° higher, was reduced to 7·4 grains; and as, on dissolving it in water, a few insoluble white particles appeared, the muriate of magnesia had begun to be decomposed.

A few drops of muriate of barytes, added to 100 gr. of the water of the Dead Sea, let fall 0·1 gr. of sulphate of barytes.

Nitrate of silver, added to 250 gr. of the water, let fall a quantity of luna cornea, which, being edulcorated and slightly ignited, weighed 163 2 gr. A little sal ammoniac was added to the supernatant solution, to separate the excess of silver, which was edulcorated and dried. The clear fluid was evaporated to about 3 oz. and a strong solution of oxalate of ammonia added warm, but not near boiling, lest it should throw down the magnesia. To ascertain the quantity of lime contained in the precipitated oxalate of lime, the oxalic acid was driven off by a low red heat, and a known quantity of muriatic acid, more than sufficient to dissolve the subcarbonate of lime thus produced, was added: the excess of acid was taken away by a piece of marble of a known weight. The quantity of lime in the selenite, according to the calculations of Chenevix, being subtracted, the oxalate of lime, thus precipitated, indicated 4·814 gr. of pure lime, equal to 9·48 gr. of muriate of lime.

The clear solution, which was about 4 oz. was concentrated to between 2 and 3 ounces, during which a white powder was deposited, which, from other experiments, was supposed to be oxalate of magnesia. To the concentrated solution was added carbonate of ammonia, with excess of pure ammonia, which rendered the mixture opake and milky, but, on the next morning,

the fluid had become quite transparent, with clusters of pellucid crystals spread over the bottom of the vessel. This salt was, no doubt, an ammoniaco-magnesian carbonate, and was exposed to a gentle heat, to drive off the ammonia; the white impalpable powder, thus left, was treated, and its quantity estimated in a way similar to that which had been employed with the lime.

The supernatant solution, although its transparency was not disturbed by caustic potash, yet, on being evaporated and calcined, it left about $\frac{1}{2}$ gr. of carbonate of magnesia. This being added to the other powder, the whole indicated 11·1 gr. of pure magnesia, equal to 25·25 of muriate of magnesia.

As 12·28 gr. of muriatic acid still remained unemployed, the quantity of common salt was estimated at 26·69 grains.

From thence the water of the Dead Sea appears to contain 3·792 per cent. of muriate of lime, 10·1 of muriate of magnesia, 10·676 of common salt, and 0·054 of sulphate of lime.

Another 150 grains of the water were treated with regard to the lime and magnesia, as in the former analysis, but the acid was not separated by silver, being only calculated from the former estimation. With regard to the common salt, 13·1 gr. of it was actually separated by evaporation, the difference of which from the former statement depends on the necessity of heating the salt to redness. In this experiment the water appears to contain 3·92 per cent. of muriate of lime, 10·246 of muriate of magnesia, 10·36 of common salt, and 0·054 of sulphate of lime: and this is probably the most accurate statement.

Although the saline contents of the water, when perfectly desiccated, are only about 25 per cent. of the water; yet if the salts be only desiccated at the temperature of 180° they will amount to 41 per cent. The common salt is scarcely at all concerned in this difference; for 100 gr. of it lost only at most half a grain by being heated to redness in a platina crucible.

The water, analysed by Macquer and Lavoisier, had probably suffered evaporation, and the proportion of salts, as found by them, is very different from that stated above; but their mode of operating did not allow of any accuracy in this respect.

The water of the river Jordan was perfectly pellucid, very soft, and had no saline taste; but chemical reagents produced, especially when the water was concentrated by evaporation, effects analogous to those observed with the water of the Dead Sea.

Five hundred grains, evaporated at 200°, left 0·8 gr. which is only 1-300th part of the solid contents of the water of the Dead Sea. Part of this residuum was not dissolved by distilled water, and it effervesced with acids; thus shewing the presence of carbonate of lime. Oxalate of ammonia threw down a precipitate weighing 0·12 gr.; ammonia and phosphoric acid threw down another precipitate, which, when the ammonia was driven off by heat, weighed 0·18 gr. The common salt could not be separated with any accuracy, but it was probably in nearly the same proportion as

in the water of the Dead Sea. Perhaps, therefore, the river Jordan may be the source of the impregnation of the Dead Sea, or the same source of impregnation may be common to both.

Observations.—From the preliminary experiments here recorded, we may learn to estimate the small reliance that can be placed upon the analyses, even of the most skilful chemists, unless they are confirmed by other analyses, made in a different manner, as we have already remarked in several instances.

On the Advantages of malleable Zinc, and the Purposes to which it may be applied. By Mr. CHARLES SYLVESTER.—*Phil. Journal, No.* 81.

ZINC might, from its attraction for oxygen, be supposed to be very changeable when exposed to water and air; but whether in sheets or wire, it underwent, even in damp rooms, no other change than that of colour. Polished zinc loses its lustre, and acquires a blue grey colour; this oxide is imperceivably thin, but so excessively hard and insoluble, that it resists all future attacks of the air and water.

Zinc is also less liable than copper to waste in sea water, or even in strong brine, and hence it may be readily applied to the sheathing of ships.

It possesses many advantages over lead and copper for roofing houses, forming cisterns, pumps, pipes, &c. being equally durable, and not deleterious. Although lighter than lead, it is fifteen times as strong, and if the sheets are only 1-7th the thickness of lead, they come to only 1-3d of the price. They may be rolled as thin as 6 ounces to the square foot, and are generally manufactured 2 feet by 4.

The observations of Mr. Davy on Mr. Sylvester's former experiments (see Retrospect, vol. iii. p. 281) do not seem decisive on the subject, and he hopes soon to confirm his former assertions.

Observations.—The uses of zinc have been already stated, and therefore we must regard the principal part of this paper as a mere advertisement by one of the patentees of the article he has for sale. How far the editors of philosophical journals are warranted to insert these oblique puffs of patentees, we shall not stop to inquire; but shall only hint, that, if the practice continues to increase as it has done of late, few will probably think it worth their while to purchase these monthly newspapers.

Mr. Sylvester does not indeed refer us to his own house for purchasing the zinc plates, but kindly mentions the houses in Bristol and London where orders are received.

On the probable Composition of Sulphur.—Phil. Magazine, No. 115.

Sulphur appears to be compounded of the electric fluid, and some atmospheric gas, from the following considerations:

1. A sulphureous odour attends the brisk excitement of the electrical machine.

2. This smell is also perceived in thunder-storms.

3. After a violent thunder-storm in America, the windows of a chamber were found covered with real sulphur.

4. Sulphurets of copper and iron emit light in any gas, or even in a vacuum; which is also a property of the electric fluid: so that sulphur and the electric fluid are the only two substances in nature which shine without oxygen.

5. Priestley and others suspect the electric fluid to possess acid properties; so that it, in some measure, coincides with sulphuretted hydrogen.

6. The fumes of sulphur, and the electric fluid, both whiten red roses.

7. Priestley found sulphur upon lead ore when the electric explosion was passed over it. May not the same be procured if pure lead is employed? And are the black grains produced when wire is melted by an electric explosion, a sulphuret, or sulphuretted oxide of the metal?

Many conjectures may be made on the universality of the operations of the electric fluid; it may perhaps be a component part of all simple combustibles; to it oxygen may owe its power of supporting combustion, and its acidifying principle, especially as it possesses the properties of combustion and acidity without the apparent presence of oxygen. The [oxygenized] muriatic acid may owe to it the quality of decoloration, and it may have a great share in the formation of nitre.

Observations.—That the electric fluids and sulphur contain some common principle, which, combining with some other ingredient in the atmosphere, may produce sulphur, is probable. Unfortunately, the subject of electricity having fallen into the hands of the physico-mechanical experimenters, we have had little more than ingenious variations of the single experiment of charging and discharging a plate of glass; and the chemical history of the electric fluids is almost entirely unknown. The brilliant discoveries of Mr. Davy will, it is to be hoped, be followed up by other philosophers; and the production, nature, and effects of the imponderable fluids receive their merited attention from chemists.

An improved galvanic Trough. By Mr. C. Wilkinson.—*Phil. Mag. No.* 115.

Considerable difficulties arise in galvanic experiments, in regard to emptying the troughs, and correcting any defects as to the plates becoming unsoldered, or the trough leaking. To prevent these, a box was formed on the principle of Volta's couronne des tasses, by using wooden partitions, about $\frac{1}{2}$ an inch from one another, and covering the whole with cement.

The copper and zinc plates are then soldered at the ends of a copper wire, bent in the shape Π, with a ring soldered at the top; so that when an experiment is concluded, the plates may be lifted up at once, by passing a wire through all the rings. This bent wire is to be placed on each partition, and the zinc plate of one wire is to be in the same cell with the copper plate of another wire, the plates not touching each other. When the plates are withdrawn, the acid may be left in the trough. As no part of the plates is covered with cement, the trough is more powerful than the common ones of the same size.

On the Inflammation of Sulphur, by Mixture with brown Oxide of Lead.—Ann. de Chim, May 1807.

Mr. Thomson said (Ann. de Chim. Nov. 1806) that he had unsuccessfully attempted to repeat the experiment of Vauquelin, of inflaming sulphur by triturating it with brown oxide of lead, and therefore he supposed that the oxide employed by Vauquelin, was combined with some hyperoxygenized muriate of lead.

Vauquelin has lately repeated his experiment, in his chemical lectures, before Proust and a number of other auditors. He never employed the oxygenized muriatic acid to prepare the brown oxide, but only took the precaution to boil nitric acid for a long time upon the oxide, in order not to leave any minium in it, and then, after separating all the nitrate of lead, by a plentiful use of boiling water, to dry the oxide and triturate it with very dry flowers of sulphur.

On the Formation of phosphoric Ether by a peculiar Apparatus. By Mr. P. F. G. Boullay.—*Ann. de Chim. May* 1807.

Scheele and Lavoisier attempted unsuccessfully the preparation of phosphoric ether. Boudet junior was more lucky; yet the liquor he obtained, although it had a peculiar smell, was only slightly volatile, and was totally soluble in water.

500 grammes (16 oz.) of pure phosphoric acid, of the consistence of honey, was heated, in a tubulated retort, to 95° Réaum. and then an equal weight of alkohol at 40° was made to fall, drop by drop, into the acid from the glass cock of a *tritorium*, which was inserted into the tube of the retort. The mixture was attended with boiling, and it became black. The distillation being continued to dryness, the receiver, which had been environed with ice, was found to contain,

1. 120 grammes of alkohol, slightly etherified.

2. 260 grammes of a light, white, strong-smelling liquor, more ethereal than the former.

3. 60 grammes of water, saturated with ether, upon which swam about 4 grammes of an empyreumatic, citron-coloured liquor, analogous to what used to be called sweet oil of wine.

4. Another liquor, very fetid, which reddened tincture of litmus, and effervesced with carbonate of potash. On evaporation, it left a foliated deliquescent mass, resembling acetate of potash.

Lime-water through which the gases expelled were made to pass, became turbid towards the end of the distillation.

A gas was collected of an agreeable penetrating smell, which burnt with a white flame, and thus deposited an abundant carbonaceous residue on the sides of the bell-glass; so that it was merely ether that had escaped condensation.

A glossy black residuum remained in the retort, composed of phosphoric acid and charcoal.

The two first products, rectified upon dry muriate of lime, yielded about 60 grammes of very pure ether, whose taste and smell resembled that of sulphuric ether. It marked 60° Beaumé at 10° Cels. It dissolved in 8 or 10 parts of cold water. It evaporated rapidly. It boiled at 30°. It dissolved resins and phosphorus. It burnt with a white flame, and left a carbonaceous residuum. It left no traces of any acid when burned upon water.

The etherified alkohol, which afterwards passed over in the rectification, being again treated with phosphoric acid, produced more ether.

Hence phosphoric acid may be made to change alkohol into a perfect ether, which more strongly resembles sulphuric ether than those formed by the other acids.

Observations.—We have not the least doubt of the efficacy of this process, as it prevents the distillation of the alkohol before the acid has been sufficiently heated to act upon it. We should indeed attribute the failure of the trials made by Scheele and Lavoisier to their administering the heat too slowly. If the alkohol was first mixed with the acid, and the mixture distilled with

as sudden a heat as could be prudently applied, we think it probable that Mr. Boullay's apparatus would not be necessary, but that the ether might be obtained, even if the ordinary vessels were used.

On camphorated Water. By Mr. C. A. Cadet.—*Ann. de Chim. May* 1807.

Carbonic acid has been said to augment the proportion of camphor that may be dissolved in water. But, on repeating the experiment, it was found that a quart of pure water took up 16 grains of camphor, while water impregnated with carbonic acid gas, according to the method of Mr. Paul, only took up 15 grains.

As the camphor probably lost part of its weight, by the evaporation that took place during the operation, experiments were instituted to discover a reagent, which would detect the presence of camphor in water. Soda, or ammonia, do not precipitate camphorated water, nor carbonate of potash; but pure potash precipitates the camphor, yet, if the vessel is left exposed to the air, the liquor reassumes its transparency, by means of the carbonic acid gas that it absorbs from the atmosphere.

This offers a new method of distinguishing potash from soda, and one that is much easier to employ, as also more secure, than the nitromuriate of platina. That salt, however, is preferable, because it precipitates carbonate of potash.

It requires a great excess of pure potash to precipitate camphor from water charged with carbonic acid; and the precipitate is not more considerable than when camphor dissolved in pure water is employed.

Hence it appears, that carbonic acid does not augment the solubility of camphor in water, and that the water not only takes up the aroma of the camphor, but even its whole substance. If the camphor is previously triturated with a few drops of alkohol, a larger quantity is taken up by water, for some chemists have by this means dissolved 30 grains in a quart of water.

Observations.—It can hardly be imagined that chemists will have recourse to camphorated water, to distinguish pure potash from soda; as far preferable means are known. And the smell of camphor is so strong, that it can seldom be necessary to lavish away pure potash, in order to discover its presence.

On the spontaneous Decomposition of hydroguretted Sulphuret of Barytes. By Messrs. ROBIQUET *and* CHEVREUL.—*Ann. de Chim. May* 1807.

A BOTTLE, half filled with hydroguretted sulphuret of barytes, and in which crystals were formed, was turned up, without being unstopped, and left for some days. The temperature having lowered, the liquor yielded crystals different from the former.

The first crystals were very long prisms, and yielded sulphurous acid gas, on adding sulphuric acid; sulphur mixed with sulphate of barytes being at the same time precipitated. Hence they appear to be sulphuretted sulphite of barytes.

The second crystals dissolved in weak muriatic acid, without effervescing, and were totally soluble in water: this solution was precipitated by the sulphuric and carbonic acids. The crystals, therefore, were only pure barytes.

The mother-water was very limpid, and had all the characters of barytes-water.

It appears, therefore, that the hydroguretted sulphuret of barytes absorbs the oxygen in the void space of the bottle, and forms water and sulphurous acid; but the oxygen being not sufficient to convert the whole of the sulphuret into sulphite, the sulphite that is formed separates the sulphur from the barytes; and the sulphuretted sulphite being less soluble than barytes, crystallizes before it.

Oxygen, therefore, converts hydroguretted sulphuret of barytes into sulphite, and not into sulphate, notwithstanding the attraction of barytes for sulphuric acid. And sulphur is attracted by the sulphite of barytes more strongly than by barytes.

Observations.—These experiments furnish a fresh instance of the tendency of sulphur to unite with the salts formed by its acid, at the lower degree of oxygenizement. Or may we not say, that it forms an oxide, or perhaps another acid, with less oxygen than is contained in the sulphurous, which has not as yet been exhibited in an uncombined state, on account of its easy decomposability into sulphur and sulphurous acid?

On a white, crystalline, fulminating Combination of Silver. By Mr. DESCOSTILS.—*Ann. de Chim. May* 1807.

A DETONATING powder has been lately sold at Paris, folded up in a card, which being held over the flame of a candle detonated with a sharp noise and violet-coloured flame. The card is found torn, and smells as if burnt; the part next the powder is covered with a greyish white metallic coating.

This substance was found to be a combination of oxide of silver, ammonia, and a vegetable substance, and of course analogous to the fulminating quicksilver of Howard, and might be called detonating silver, to distinguish it from Berthollet's fulminating silver.

It may be made by putting silver into nitric acid, and heating it till the solution commences; then, after taking it from the fire, adding a sufficient quantity of alkohol, to prevent the emission of nitrous gas. The temperature of the acid is increased, the effervescence recommences, and a strong smell of nitrous ether is perceived. The liquor becomes turbid, and deposits a crystalline, white, very heavy powder, which ought to be separated as soon as it ceases to increase, and then washed, several times, in small quantities of water.

Or alkohol may be added to a solution of silver, with excess of acid; the temperature is greatly increased, and the powder is quickly deposited.

This powder is scarcely changed by light. It detonates by heat, the electric spark, a quick stroke, or a continued rubbing; but not by pressure, unless violent. It is slightly soluble in water, and has a very strong metallic taste. It detonates with concentrated sulphuric acid, but the diluted acid decomposes it slowly. Muriatic acid decomposed it immediately, and formed such a quantity of muriate of silver, as shewed the detonating silver to contain 71 per cent. of silver: in this operation a smell of Prussian acid was perceived, but no sensible quantity of that acid could be collected. Nitric acid, by being boiled on it, changes it into nitrate of silver and nitrate of ammonia; sulphuretted hydrogen decomposes it; ammonia and a vegetable substance are left in the liquid; potash decomposes it, and separates black oxide of silver and ammonia. It is soluble in ammonia, and may be again separated from that solvent by a gentle evaporation.

This detonating powder is one of the most active metallic poisons; very small doses made cats expire in the most horrible convulsions.

Observations.—It is perhaps not altogether unnecessary to caution persons, who may be inclined to make some of this powder, to prepare it only in very small quantities, in order to avoid the great danger that would otherwise attend the operation.

On sulphureous mineral Waters. By Mr. Westrumb.—*Ann. de Chim. May* 1807, *from Gehlen's Neue Jour. de Chimie, Vol. V. No.* 1.

All sulphureous waters contain hydrosulphuret of lime, as is shewn by first boiling the water in close vessels to expel the sul-

phuretted hydrogen gas and the carbonic acid gas, and then adding, 1. sulphuric acid, which expels more sulphuretted hydrogen, and precipitates sulphate of lime; 2. fuming nitric acid, which separates sulphur; and 3. oxalic acid, which also expels sulphuretted hydrogen, and forms oxalate of lime. The water evaporated in open vessels, lets fall sulphate of lime, and yields sulphuretted hydrogen gas.

By passing the gases that are expelled through lime-water, or a solution of acetate (sugar) of lead, the quantity of the gases may be very accurately determined; as every 20 grains of the carbonate of lime precipitated, when lime-water is employed, will indicate 10 cubic inches of carbonic acid gas; and every 19 grains of the hydrosulphuretted oxide of lead will indicate 10 cubic inches of sulphuretted hydrogen gas.

Gimbernat and Schaub pretended to have found sulphuretted azotic gas in the water at Aix-la-Chapelle, and at Nenndorf, in Hesse. This gas has the same smell as sulphuretted hydrogen gas; it is not decomposed by carbonic acid gas, or nitrous gas; it is decomposed by strong nitric acid, which separates sulphur from it; it is neither inflammable itself, nor does it maintain combustion; it forms sulphurets with metallic solutions; and it can only be separated from water by a long boiling.

But if sulphuretted hydrogen gas be washed with milk of lime, or passed through it, the gas acquires the above qualities. An acid being afterwards added to the milk of lime disengages common sulphuretted hydrogen gas. So that this sulphuretted azotic gas is a product of the operation; but it is doubtful whether it is produced by the action of lime upon sulphuretted hydrogen, or if this substance contained the sulphuretted azote.

The sulphurated mineral waters contain also carbone, as they yield a new principle, viz. *stinckendes schwefelharz*, i. e. fetid resin-of-sulphur.

The water must be evaporated in open vessels, and the residuum treated with alkohol, which takes up this resin, along with the earthy muriates. The alkohol being evaporated, deposits a yellowish grease, which becomes brown and resinous. By repeated solution in alkohol, and evaporation, this substance is decomposed into sulphur and a blackish brown resin, which smells very strong, like garlic, or like assafœtida when just separated from alkohol, by adding water. The solution acts like an acid. The resin dissolves in ammonia, the solution is yellow, and resembles sulphuretted ammonia. With lime-water it forms a hydrosulphuret. All these solutions act upon metallic combinations like sulphuretted hydrogen.

As the sources of these mineral waters arise in beds of coals, this resin may perhaps be found in coals.

At the baths of Eilsen, and of Saint Amand, a black mud collects, which has been found to contain this fetid resin, hydrosul-

phuret of lime, sulphur, lime, alumine, magnesia, charcoal, sand, some fibrous substances, a little sulphuretted hydrogen gas, and carbonic acid gas.

This fetid resin and charcoal may also be formed from pure sulphur, by digesting it (when newly precipitated from a hydroguretted sulphuret by an acid) in alkohol. The alkohol, on distillation, deposits crystals of sulphur, and a yellowish grey powder; at which period the fetid resin is to be found in the supernatant liquor.

It might be supposed that the alkohol is necessary to the formation of the fetid resin, especially as its peculiar smell is perceived as soon as alkohol is added to the residuum of sulphureous mineral waters; but several observations seem to shew that it derives its origin from the sulphur itself.

On the fetid Resin of Sulphur. By Mr. Roloff.—*Ann. de Chim. May* 1807, *from Gehlen's Neue Journ. de Chim.*

Mr. Michaelis having precipitated the golden sulphur from the antimoniated hydroguretted sulphuret of potash, by sulphuric acid, evaporated the supernatant liquor, which contained sulphate of potash. During this evaporation, the vapour was almost insupportable, and smelt like burnt assafœtida; the residuum was grey. The residuum treated with alkohol, acquired the smell and taste of garlic, and yielded, on evaporation, a sticky grey matter, of the same taste and smell.

As the matter had this smell before the alkohol was added, the alkohol cannot be said to be necessary to its formation.

Observation.—These remarks confirm the opinion of Mr. Westrumb, relating to the origin of the fetid resin.

On an Improvement in the galvanic Trough.—Phil. Journ. No. 82.

Wilkinson's improvement of the galvanic trough, on the principle of Volta's couronne des tasses, is attended with the inconvenience of having the cement sometimes melted, in consequence of the increased action of the acid upon the zinc. It is therefore better to make the partitions of glass, and of such a size that the metallic plates may not touch the bottom or sides of the trough by half an inch. These partitions may be made of common crown glass; and should be ground smooth at top.

Observation.—This method of constructing a galvanic trough is superior to that of Wilkinson, noticed in a preceding article;

but it surely would be better to form the whole of glass, cast in a mould, and thus no cement whatever would be required.

An Account of the Relistian Tin Mine. By Mr. Joseph Carne. —*Phil. Trans. for* 1807.

The Relistian tin mine is nearly on a level with the surrounding country. The lode runs east and west, and is found at 12, 25, 50, 65, 75, 81, and 90 fathoms from the surface: it is of different widths, not exceeding 36 feet, which diminishes at the distance of 100 fathoms east to 5 feet. In some parts, besides the metallic substances, schist predominates, in others chlorite; quartz is throughout the smallest component part.

A flookan, about two inches wide, bearing south-east, cuts the lode at an angle of 45°, and heaves as well as disorders it. At 75 fathoms deep, the flookan became 4 inches wide, about 8 fath. north of the widest part of the lode; it continued of that size for 10 fath. and then diverged into 4 branches, which were continued through the lode. Of these branches, the first 3 feet were composed of copper pyrites, and then a body of pebbles, nearly 12 feet square, was found, extending in width to the two outer branches of the flookan. Scattered bunches and single pebbles were found 4 fath. above, and 6 fath. below this place.

In this part of the lode, schist predominates, and the pebbles themselves are generally composed of schist, cemented by the same substance, chlorite, or oxide of tin, which latter is generally crystallized: in some of the crevices there is a little copper pyrites. About half a score pebbles are composed of tin in quartz, coated with chlorite.

On the Phosphorescence of Bodies from the Action of the electric Explosion. By Mr. William Skrimshire.—*Phil. Journ. No.* 82.

These are a continuation of his electric experiments (see Retrospect, vol. ii. p. 511), and they include the combustibles, and metallic bodies; he intends to extend them through the vegetable and animal kingdoms.

Brimstone does not give sparks, and is scarcely luminous by the shock. Flowers of sulphur are not phosphoric.

Phosphorus inflames both by the spark and shock.

Some kinds of charcoal afford sparks, and are phosphorescent; but other pieces did not become phosphoric. Coke and coals give a good spark, but are not luminous by the shock. Peat, crude or charred, affords a good spark, but is scarcely luminous.

Elastic bitumen, dark brown brittle bitumen, jet, and asphal-

tum, do not give sparks, but the fluid spreads uniformly and silently over the whole surface, and passes along it like the electric light in an exhausted receiver. The two first are luminous by the shock, but not the latter.

Amber does not give sparks, but is phosphorescent.

Plumbago gives good sparks, and is not phosphoric.

Blacklead crucibles afford flame-coloured sparks, purple on the surface, and become luminous when the shock is taken above their surface.

The metals are excellent conductors, and afford good sparks; but not one of them becomes phosphoric by an explosion. Neither do cinnabar, ethiops mineral, mundic, galena, blend, the sulphurets of antimony, minium, litharge, and some other oxides, become phosphoric. Some ores and oxides, as red and yellow arsenic, hæmatites, pyrites from chalk-beds, oxide of zinc, and oxide of antimony, are very slightly luminous; but not a single ore or oxide affords a brilliant phosphoric appearance.

Beccaria, during his experiments on solar phosphori, could not succeed in rendering metals phosphoric. Indeed, as the phenomena of solar phosphori, and the phosphorescence of bodies exposed to the light of an electric explosion, proceed from the same cause, they must be subject to similar laws.

On the Decomposition of the fixed Alkalies by Galvanism. By Mr. Charles Sylvester.—*Phil. Journ. No.* 82.

Pure and white potash was exposed on a plate of platina, to a surface of 1400 square inches. As soon as the platina wire was brought in contact with the potash, a quantity of gas was evolved, and the alkali assumed a blackish colour; sparks were frequently emitted, which effect is peculiar to charcoal and the metals.

A second experiment was made, with an additional pair of troughs, of the same surface; and to avoid the inconveniency of the deliquescence of the potash, the alkali, slightly moistened, was placed in a glass tube, with a platina wire sealed into one of its ends, and the other wire passed through a cork at the other end of the tube. A quantity of gas was evolved, which from time to time exploded by the sparks produced. The temperature of the mass was increased, and a larger quantity of the black matter was produced than before. This black matter was deposited on the alkali being dissolved in water. Small portions of the black matter sticking to the end of the wire detonated, by contact of water, with a vivid flash; and the same effect was produced on pouring water into the tube.

This detonation cannot be produced from potash in any state of dryness.

Observation.—It appears from an anonymous letter, in the same number of the Phil. Journ. that an accident has occurred from the violence of the detonation; it will therefore be proper to secure the eyes of the operator by wearing gogglers.

On the Firedamp of Coal-mines. By WILLIAM HENRY, *M. D.* —*Phil. Journ. No.* 82.

Two bladders were filled with firedamp, by being tied to a funnel luted over one of the crevices in a coal-mine, in the neighbourhood of Newcastle on Tyne, from whence the gas issues, sometimes with considerable force. The gas in these bladders was examined about seven days afterwards, while the bladders were dry, and shewed no signs of putrefaction.

It had a disagreeable smell, it burned with a dark blue flame, and produced moisture. Mixed with common air, it did not detonate, but it gave a loud report with oxygen. No sulphuretted hydrogen could be discovered in it. The gas contained 63.34 per cent. by measure, of atmospheric air; 1.66 of carbonic acid gas, and 35. of inflammable gas, which, as it required twice its bulk of oxygen for combustion, and yielded its own volume of carbonic acid gas, appeared to be carburetted hydrogen. The gas therefore differs very little from the gas of stagnant water, and that obtained from pit-coal by distillation; but the last contains a variable proportion of sulphuretted hydrogen.

Another parcel of gas was collected as it issued through water on the floor of the mine, and carried to Edinburgh. Dr. Thomson found it to contain 6.5 per cent. in measure of oxygen; 25.5 of azote; 5.0 of carbonic acid gas; and 63. of inflammable gas. One hundred measures of this inflammable gas appeared to require 269.4 meas. of oxygen for its combustion over water, and 246. over quicksilver, and to produce 98.4 meas. of carbonic acid gas, in the first case, and 90.6 in the second.

The firedamp does not seem to be produced from the decomposition of pyrites by water, as it is not mixed with sulphuretted hydrogen; nor from the decomposition of water by coal, as it contains such a small proportion of carbonic acid gas. It seems to be disengaged from coal by heat, which may perhaps be communicated by contiguous beds of pyrites, acted on by the occasional influx of water, being generated most abundantly after heavy rains.

Its analysis shews it not likely to be decomposed by any chemical means; and that it can only be got rid of by a well-planned system of ventilation.

On the Non-existence of Oxygen and Hydrogen as Bases of particular Gases; on the Action of Galvanism; and on the compound Nature of the Matter of Heat. By Dr. G. S. GIBBES.—*Phil. Journ. No.* 83.

THERE is not the least evidence that the ponderable parts of oxygen and hydrogen are in any respect peculiar substances, or that water is a compound resulting from the union of these two substances.

It is also asserted that the phenomena of Galvanism, like electricity, are owing to the presence, or absence, of one and the same fluid. And yet it is evident, that if two bodies acting upon a third produce different effects, the bodies themselves must be different. Now when water is galvanized, one of the platina wires produces one kind of air, and the other another; of course the two powers, which were conducted by the platina wires, must be different, and water is transformed, by the union of these two galvanic powers, into two aeriform bodies, which enter into combustion, and by that process reproduce water, and form fire. Fire, therefore, is composed of the two galvanic powers; water and the positive power of the pile produce oxygen; and water with the negative power of the pile produces hydrogen.

It is therefore the positive end of the battery which produces the effects on bodies usually attributed to oxygen; and it is not the basis of the air, but the expansible power, which causes water to assume that aeriform state. In like manner, the negative end of the pile reduces metallic calces, by the oxidated or positive state of the metal being saturated with the hydrogenous or negative power of the pile.

Again, metals not easily burned are rendered more combustible by being connected with the negative end of the pile. Hence, although copper precipitates silver from nitric acid, yet if silver be connected with the pile, it will precipitate copper in its metallic form; which fully proves that a real and distinct power is communicated by the pile.

Mr. Davy has shewn that neutral salts are decomposed by the action of the pile; the acids appearing on the positive side, and the bases on the negative: and that muriatic salts yield the oxygenized muriatic acid by this means.

The galvanic apparatus resolves the matter of heat into its two constituent principles; one of which with water forms oxygen gas, and with other principles, acids and metallic oxides, &c.; while the other principle of heat forms the various combustible bodies. Experiments to illustrate these positions will be given in a future paper.

Observations.—The experiments of Ermann (see vol. ii. p. 223), and which are allowed to be correct, are a convincing proof of the existence of two electric fluids, viz. the vitreous and the resinous; since they are there shewn to differ in respect to the bodies by which they are conducted. We are inclined, however, from the general similarity of their effects, to suppose that they differ only in respect to the proportion of the principles of which they consist, in the same manner as the several oxides of one and the same metal, or as the several acids, respectively produced from sulphur, phosphorus, or arsenic. But what these principles are, must remain at present unknown. This compound nature of the electric fluid adds considerably to the plausibility of Dr. Gibbes's theory; but it is not to be expected that detached hypotheses will supplant the compact body of chemistry which the adherents of the French school have formed. Of this we have a sufficient proof in the original and certainly imperfect hypothesis of Lavoisier respecting combustion being still retained in elementary works, without being corrected either by the hypothesis of Brugnatelli, or by that of Gren and Thomson.

Further Experiments on Potash and its Base. By Mr. C. Sylvester.—*Phil. Journ. No.* 84.

On repeating his former experiments with an increased power, the metal was produced, detached from the alkali, in which it is imbedded.

The black matter mentioned in the former paper was formed at the end of the wire coming from the copper end of the apparatus only. It did not seem to be carbone, when added to nitre in a platina spoon; the quantity however was too small for any accuracy in this respect.

It remained permanent in water for several weeks, and therefore cannot be an oxide with less oxygen than potash; and as it is formed at the copper end, it is not an oxide with more oxygen than potash. Is it any foreign matter derived from the vegetable?

Plants furnish more alkali by incineration than by any other process; hence it does not exist in them in that form, nor can it exist in the state of the base on account of the vegetable fluids. In what form then does it exist?

It is probable that the earths are, like the alkalies, compounds of oxygen. Of course the nomenclature of chemistry must undergo an alteration. And in this new arrangement all ponderable matter will most likely be divided into two classes of simple bodies, namely oxygen and inflammable bodies; after which will follow the compounds, first those formed by the union of inflammable bases, secondly the simple and compound oxides. The simple oxides will include the oxides properly so called, the acids,

the alkalies, and the earths. The compound oxides will include the various genera of neutral salts.

A spontaneous explosion of the alkaline base also occurred, which fractured the glass tube in which the experiment was made.

Observations.—To divide all ponderable bodies into two divisions, one containing a single species, and the other all the rest of those bodies, is certainly contrary to the rules of logic; and yet there seems to be a necessity of submitting to this anomaly. In respect to the alteration that will necessarily take place in some particulars, we shall rejoice to see the term calx revived in lieu of oxide, as there certainly existed no occasion for the alteration in English, although it was a great improvement in the language of French chemistry, to get rid of the term *chaux*, as applied to metals, as it was also used in common language to denote lime.

AGRICULTURE.

A Method of improving Grass Lands. By Mr. William Salter, *of Whinberg.—Farmer's Magazine, No. 33.*

Mr. Salter entered upon an extensive farm of wet, cold, springy land, at Michaelmas 1795; about one hundred acres of which were bad meadow, so overrun with rushes, sedges, and all sorts of aquatic plants, that no sheep had ever been known to have been pastured there. He first opened the rivulet which ran through the meadow to the breadth of eight feet, and cut many open drains to communicate with it. The turf cut out of these drains, when dried, he gathered into heaps, and burnt to ashes in the following February and March, and spread about fifteen loads of ashes over every acre; and then sowed nine pounds of Dutch clover, and two bushels of rye-grass, to the acre; and upon that part of the meadow which was boggy and rushy, he laid from 80 to 100 loads per acre of sand, fine gravel, or mold, whichever was the most attainable; which, as well as the rye-grass and clover, were brushed in with a brush harrow. In the commencement of April he dibbled upon every acre two bushels of summer vetches, one bushel of early grey peas, and two bushels of Poland oats, all mixed together; omitting the oats however upon the dry part of the meadow. He remarks, that in dibbling in this manner the holes ought to be four inches every way from each other; and three or four seeds should be put into a hole. Peas and vetches thus growing upon grass land, have never failed with him of producing an excellent effect; as they

have entirely destroyed moss, and ameliorated the soil. When the crop gets forward in the pod, he mows it for hay; and as soon as it is dry puts it into small cocks, and then into large ones, so as to prevent the leaves from falling off. This hay he reserves for his sheep, and gives any surplus to his horses; and he finds it so nutritious, that it serves them both for hay and corn. Some of this hay he has frequently cut into chaff, and given to sheep and lambs, and has found them thrive better upon it than upon turnips, as the ewes had more milk for the lambs; and the manure made in the yard in which they were kept was the best manure he ever had, and was far superior to that from bullocks. This mode of managing grass lands he has repeated since in several cases upon bad land, and uniformly with similar success, though he has discovered that rye-grass will not do well on dry land, and therefore he omits it in that case. He was led to adopt this plan for improving grass lands from a mere accident. In 1784 he had a piece of grass land; he sowed vetches upon it, and harrowed them, and they produced so good a crop that he continues the practice; and whenever his clover crops fail, he dibbles or drills vetches among them early in the spring. He considers it worthy of remark, that the rye-grass and Dutch clover upon the meadows come much earlier and grow much faster than upon the arable lands. He never ploughs, pares, or scarifies his grass land.

Observations.—The method of improving grass lands, introduced by Mr. Salter, is deserving of very general adoption on wet soils, which are overrun with moss; but it seems unnecessary to sow oats in any case, as they certainly tend to exhaust the soil, without sheltering the native grass by the close covering which peas and vetches afford, from which circumstance arises the greatest benefit from sowing them. The previous operation of draining off the wet would of itself tend much to the destruction of noxious aquatic plants, for these always perish if deprived of a constant moisture. There is no doubt but that the chaff cut from the hay of this green crop is the best possible food for sheep, particularly for ewes, as it supplies nourishment and produces milk in the greatest abundance. The improvements of Mr. Salter have been examined by Sir John Sinclair, Mr. Coke of Holkham, and other celebrated agriculturists, and have been sanctioned by their unqualified approbation.

On the proper Kind of Seed Wheat, and the Causes of Smut and other Disorders to which that Grain is liable. By Sir John Sinclair, *Bart. President of the Board of Agriculture.—Farmer's Magazine, No.* 33.

It is intimated in this paper, that the practice of using young seed instead of old seed has greatly contributed to occasion the

smut, and the other disorders to which wheat is liable, on the principle that whatever weakens the plant must sooner or later become the cause of disease; and it is contended, that as young seed germinates immediately, and as the flour it contains is not so thoroughly ripened, the young plant must be necessarily weaker; whereas old seed lies for a considerable space of time in the ground before it germinates, takes a stronger hold of it, the flour by which the young plant is sustained is in a more perfect state, and the plant itself being stronger is consequently less liable to disease. This hypothesis is supported by its analogy to the admitted fact, that in men and other animals gradual growth is a sign of health and longevity, and from the observation that the fine thin-skinned American wheat is very liable to mildew, which is attributed to its too rapid germination.

The honourable Baronet conceives, that the practice of using young seed was first introduced in seasons when the high price of the market tempted the farmer to dispose of all his old stock, and that the practice prevailed from the circumstance of the new corn appearing so speedily above ground. A Mr. French, of Billericay in Essex, is mentioned, who constantly uses old seed, and never has any smutty wheat, and his crops are remarkable: the father of this gentleman is stated to have pursued the same plan with the same success.

These observations are avowed to be made for the purpose of stimulating inquiry into this subject; and Sir John Sinclair thinks it would be of great use to ascertain, whether wheat is best preserved in the straw or in sacks;—whether young seed might not be improved by being slightly kiln-dried, so as not to injure the germ, as this would consolidate the grain and harden the flour;—whether the subject which occasions smut (as it must possess either animal or vegetable life) is not destroyed, or at least weakened, by the corn being kept a year;—whether steeping is as necessary for old wheat as for new;—and whether it is not owing to the weakness of the plant, and not to blights and other aerial influences, that this grain is liable to smut and other disorders. He asserts, that spring wheat is less liable to mildew and other disorders than winter wheat, which difference may be occasioned by the former never being sown till fully ripened. The paper concludes with a strong recommendation to agriculturists to make experiments as to these points, and communicate the results to the Board of Agriculture.

Observations.—If the opinions now laid down respecting the diseases of wheat shall be confirmed by future experiments, the writings of Sir Joseph Banks, and other less celebrated authors, must be considered as merely ingenious speculations. That keeping wheat till it be perfectly dry and hardened before it be sown,

may have a tendency to preserve the young plant from weakness, and consequently from disease, is a doctrine too consonant to reason to admit of controversy; but that this should be a specific against all kinds of diseases to which wheat is liable in its future growth, cannot be conceded even to the very respectable authority from whence the opinion is derived. In the extensive downs of Wiltshire and Hampshire the wheat is regularly sown before the commencement of harvest, and consequently old seed must necessarily be used; the same practice also obtains in some parts of the counties of Northampton, Oxford, and Gloucester; and yet in all these parts both smut and mildew are known, though perhaps their effects are not so generally felt as in some other parts; but the circumstance of their prevailing at all there, is a proof that using old seed is not a certain preventive of these diseases. And if new corn, when used as seed, generally produces them, how can it happen, as it frequently does, that one part of a field shall produce smut ears, and be injured by the blight or mildew, while other parts of the same field are safe from both? Till this be satisfactorily accounted for, it cannot be granted that the use of new seed is the cause of diseases in wheat, though probably the habit of plants growing from seed which has not been perfectly dried, may be both more susceptible and more retentive of disease than the habit of plants which were nourished in their infancy by the perfect farinaceous nutriment afforded by ears longer dried. The experiment of drying seed wheat on a kiln appears to be attended with much danger to the vegetative principle, for it is difficult to ascertain what degree of heat may be applied with safety; and if that could be ascertained, there would be a difficulty in never exceeding it; so that the hazard of loss of crop will counterbalance any expected advantage from this practice. After all, the importance of the subject, and the authority of the writer, entitle the paper to much consideration; some advantages and some information may result from the experiments recommended, though neither the one nor the other will probably be of the great use anticipated by the honourable President of the Board of Agriculture.

An approved Receipt for making Gooseberry Wine, which has often been mistaken for foreign Wine of a fine Quality. Communicated by a Gentleman in Forfarshire.—Farmer's Mag. No. 33.

The process recommended for the attainment of this excellent liquor is described as consisting in putting to every Scotch pint of full-ripe gooseberries mashed, an equal quantity of water milk-warm, in which has been previously dissolved a pound of single refined sugar: the whole is then to be well stirred, and the tub covered up with a blanket, to preserve the heat generated by the fermentation of the ingredients. When they have remained in

the tub three days with frequent stirrings, the liquor may be first strained through a sieve, then through a coarse cloth, and afterwards put into the cask, which should be kept full, where it will ferment from ten days to three weeks, at the end of which period two or three bottles of whisky or brandy should be put into the cask, but brandy is preferable; and to make it very good, and that it may keep well, as much sherry should be added, with a quarter of an ounce of isinglass perfectly dissolved in water: the cask should then be bunged up, the closer the better; and in a fortnight, if clear at top, it may be tasted, and more sugar added if it be not sweet enough. After being six months in the cask it may be bottled; but the sooner it is bottled after being quite fine, the more it will sparkle and resemble champaign.

Observations.—Of the utility of this receipt for the purpose for which it is intended, no doubt can remain in the minds of those who have been accustomed to manufacture wines from our domestic fruits. We do not presume to say that this is the very same receipt as was possessed by the wife of the Vicar of Wakefield, whose excellent gooseberry wine has received an additional zest from the unaffectedly descriptive pen of Goldsmith; but we have no doubt it will produce a beverage nearly as good, though it may not be equally fortunate in obtaining another Goldsmith to immortalize its excellence.

On the suitable Remedies for the most prevalent Diseases of Sheep (in France). Read at a Meeting of the Royal Medical Society of Paris, by Professor DAUBENTON.—*Farmer's Mag. No.* 33.

THE Professor, who kept a flock of sheep in the northern extremity of Burgundy, observes, that in France sheep are not affected by any intemperature of the air, but only by the violent heat of the sun, as their wool defends them from the most intense cold; the heaviest and longest continued rains and snows, or the severest frosts, were productive of no disease, while the heat of the sun caused many to die in the field, and more would have fallen victims to it, had not proper precautions been speedily observed. This disease, which, from its cause, is denominated *the heat,* is stated most frequently to attack those sheep which are most free in blood, best fed, and most robust; the animal attacked by it gasps for breath, foams at the mouth, and bleeds at the nose; the eyeballs become red, the animal droops its head, staggers, and soon falls dead. After death all the parts of the head and throat are of a mixed colour of red, and somewhat blackish, and the blood-vessels there appear much swelled on dissection. All these symptoms, he remarks, naturally suggest blood-

letting as a remedy, which he has always found to effect a speedy cure, if administered in time. He proceeds to enumerate the several parts of the body in which sheep are occasionally bled, and the different modes of performing the operation. But as in this disease the bleeding of the sheep must be performed quickly, and the vessel opened by the operation be so large as to give a sufficient quantity of blood, and be situated in a part of the body where there is no wool, he recommends bleeding in the cheek as a method equal and simple, and prefers it to all others. This is described as done at the spot where the fourth cheek-tooth is situated, which is marked on the external surface of the bone of the upper jaw by a tubercle sufficiently prominent to be very sensible to the finger when the skin of the cheek is touched. His words are—"To let blood in the cheek, the shepherd begins by placing an open lancet between his teeth; he then puts the sheep between his legs, and squeezes it so as to hold it fast; his left knee is rather more advanced than his right; he places his left hand under the head of the animal, and grasps the under jaw, so that his fingers are under the right side of that jaw near its hinder extremity, in order to press the angular vein which passes in that place, and to make it swell: the shepherd then touches with the other hand the right cheek of the sheep, at the spot nearly equidistant from the eye and the mouth; he there finds the tubercle which is to guide him; he can only feel the angular vein swelled below this tubercle; he then takes in his right hand the lancet which he holds in his mouth, and makes the incision from below upwards, half an inch in length, below the middle of the projection which serves to guide him."

Professor Daubenton also remarks, that there is another remedy absolutely necessary for sheep in every country and in every season;—a remedy for the *itch* or *scab*, to which they are more liable than to any other disease. He conceives, that though none are exempt from it, yet that those which are best fed and most vigorous are most liable to it. It is a disease which makes continual progress, and the longer it lasts the more difficult it is to cure, for which a shepherd should be extremely attentive to watch its earliest approaches; and wherever a sheep scratches itself, or the wool is displaced, should carefully examine the part by separating the wool, to see if any real symptoms manifest themselves. The remedy which M. Daubenton prefers to all others, as most efficacious towards a cure, and least detrimental to the wool, is to dress the part affected, after moderately scratching the skin, with an ointment made by melting a pound of suet or fat over the fire, and then mixing with it a fourth of the quantity of oil of turpentine: this cheap and simple method is found to have no bad effect upon the wool, but to soften the skin, which had been hardened by the eruption, and to completely cure the disease. From much experience he pronounces this remedy to be far pre-

ferable to the infusion of tobacco, oil of juniper, solution of green vitriol, of alum, of common salt, the flower of sulphur, the grey ointment, or any of the remedies in ordinary use; and adds that it may be rendered more active by increasing the quantity of oil of turpentine.

Observations.—Notwithstanding these remarks more particularly relate to France, yet the similarity of diseases to which sheep are subject on both sides the Channel, renders them interesting to an English reader.—Though, from the difference of climate between France and England, the *heat* is not likely to prevail here to any extent, still instances may occur, and where they do, bleeding is obviously the only effectual remedy; and the mode of performing the operation pointed out by M. Daubenton is equally safe, and certainly more efficacious than any method practised in this country. The scab is a disease which occurs so frequently and so universally, and is at the same time so destructive of the health, and detrimental to the fleece of the animal, that it cannot be too carefully or too anxiously guarded against. The ointment recommended, simple as it is, is an effectual and a safe remedy, though not perhaps so speedy as some others; but infusion of tobacco, oil of juniper, and solution of salt, harden and irritate the skin still more, and are therefore hurtful to the growth of the wool; sulphur gives it a bad smell, which even remains after shearing; and the mercury in the grey ointment may bring on a salivation, to remove which internal remedies may become necessary. This ointment seems more deserving of general adoption, as a remedy for the scab, than the much-celebrated preparation of Sir Joseph Banks, mentioned in the next article.

On salving Sheep. By Severus.—*Farmer's Magazine, No.* 33.

By "salving sheep" this writer means dressing them for the scab. He states that he had a present of a few Bakewell ewes, and some of the Merino breed, which all came to him more or less scabby. He applied the common remedy of infusion of tobacco, and afterwards oil of turpentine, but in vain. He consequently despaired of effecting a cure;—but he had at last recourse to a receipt of Sir Joseph Banks, which he found in Encyclopædia Britannica, which produced an immediate good effect: in four or five days the scab began to rise, and, in a very short time, came entirely away, leaving the skin quite clean; and the flock remained perfectly healthy after the dressing.

Observations.—The receipt of Sir Joseph Banks is certainly very generally known throughout England; as it is, however, the

most approved remedy yet in common practice, and may not have reached every reader of the RETROSPECT, a copy is annexed from the Transactions of the Society for the Encouragement of Arts, to whom it was originally communicated:—"Take one pound of quicksilver, half a pound of Venice turpentine, half a pint of oil of turpentine, and four pounds of hog's-lard; let them be rubbed in a mortar till the quicksilver is thoroughly incorporated with the other ingredients; for the proper mode of doing which it may be right to take the advice, or even the assistance of some apothecary or other person used to make such mixtures.—The method of using the ointment is this: Beginning at the head of the sheep, and proceeding from between the ears along the back to the end of the tail, the wool is to be divided in a furrow till the skin can be touched; and as the furrow is made, the finger, slightly dipped in the ointment, is to be drawn along the bottom of it, where it will leave a blue stain on the skin and adjoining wool. From this furrow similar ones must be drawn down the shoulders and thighs to the legs, as far as they are woolly; and if the animal is much affected, two more should be drawn along each side, parallel to that on the back, and one down each side between the fore and hind legs.—Immediately after being dressed, it is usual to turn the sheep among other stock, without any fear of the infection being communicated; and there is scarcely an instance of a sheep suffering any injury from the application. In a few days the blotches dry up, the itching ceases, and the animal is completely cured."

On Farm Buildings, with an Account of a new Species of Roof. By Mr. JOHN GRAHAM.—*Farmer's Magazine, No.* 33.

THE observations on farm buildings are mostly relative to the question in political economy, whether the expense ought to fall on the landlord, or on the tenant, and are, therefore, little adapted to a publication which professes to confine itself to new discoveries, or new applications of those already known; but the account of a new species of roof is a proper subject for the notice of the RETROSPECT.

It is well known that few merchants vessels are sheathed with copper, and that their hulls are preserved from the worm by covering them with paper, manufactured for the purpose, called sheathing-paper, which is nailed on upon the wood, and the paper is itself secured by being covered with a coat of thin deal; and though the worms penetrate this outer deal, yet the paper, coated with tar, prevents them from penetrating into the hull of the vessel. The new species of roof, mentioned in this paper, is formed by a covering of this paper laid on boards, previously nicely fitted without any intervals between them, the paper being

first saturated with tar, and afterwards coated over with the same material. This roof is said to be equal to slates in durability, though executed at about half the expense. The practice is stated to have been introduced about twenty years ago, by a Mr. Wood, a ship-builder in Greenock, whose example was "long gazed upon in stupid silence." But, last summer, a pile of buildings for preparing alum, and a village, containing about fifty families, were erected with paper roofs of this description, which have been found to answer. The roofs are much flatter than for slating (the common proportion being one foot in height to twelve in breadth), the couples are no more than three inches in breadth by one inch and a half deep, and upon these are laid half-inch deals, dressed with a plane on the edges, so as to prevent intervals at the joints; and the external covering is sheathing paper. The sheets are prepared by being dipped in tar, at nearly the boiling point, that it may the more readily penetrate, and, after drying for two days, are again dipped in tar at a lower temperature; they are then nailed on the roof in the same manner as slates, overlapping each other exactly in the same manner; and above the whole is laid a coat of tar boiled to the consistency of pitch, on which fine smithy ashes are passed through a sieve while cooling to diminish the combustibility, and to prevent the liquefaction of the tar. Mr. William Ramsay, a chemist of Glasgow, is related to have used, instead of common tar, the tar extracted from wood in the formation of the pyroligneous acid, and, by a peculiar composition, to have made it assume as close a texture and as bright a polish as marble.

Observations.—The species of roof here described will soon be extensively adopted where wood and slates are scarce, provided its durability can be ascertained. The building at Greenock, thus roofed, which has lasted twenty years, affords a presumption in its favour; but we cannot recommend it till it has stood the test of repeated experiments.

On Ploughing by Moonlight. By GALLOVITIÆ NOVITIUS.—*Farmer's Magazine, No.* 33.

THE idea of making up for the shortness of the days in mid-winter by ploughing as many hours by moonlight, or by the assistance of lamps, as would enable a team to continue at work as many hours as in the summer, struck this *novice of Galloway*, "one day by chance as he was walking alone in the fields," and, with a perseverance worthy of a better discovery, he carried it into execution, as far as ploughing by moonlight, and professes his intention of trying next winter to plough by the light of a lamp or a lantern.

Observations.—The ingenuity of this correspondent far surpasses the value of his improvement; for Providence has, with its usual kindness, so ordered it, that, at those seasons when much ploughing is required to be done, there should be a sufficient portion of daylight to execute it in.

On the Utility of Sheep-houses in stormy Weather. By A. S.—*Farmer's Magazine, No.* 33.

The great losses of sheep, which have been so widely experienced during the late snows, induced the writer to recommend sheep-farmers to accommodate their flocks with buildings; because sheep will naturally run to such shelter at the approach of a storm, instead of the hollow places to which they otherwise resort, where they are frequently buried among the snow.

Observations.—If this writer's experience had been equal to his good sense, he would have known that the most intelligent sheep-breeders have long since provided for their flocks the accommodation of shelter, which he here recommends.

Description of a new-invented Sowing Roller. By Philarator.—*Dickson's Agricultural Magazine, No.* 6.

The implement described in this paper is made up by the union of a drill and a common roller; and the application to the principle of broad-cast husbandry, is contrived by substituting a hollow tin cylinder, with holes for the corn to fall through in the place of the drill. The drill and the roller are fixed to the same frame, and the rotatory motion of the drill or cylinder is produced from the connexion of the axis of the drill with the axis of the roller, by means of a crank, in the same manner as a common knife-grinder's wheel is formed. Indeed the whole contrivance is nothing more than a drill, with a roller substituted to give it motion instead of wheels. The several parts of the machine are described in the paper with verbose minuteness, and the description is illustrated by a plate;—but were the most particular account to be here given of all the parts, it would not convey a clearer idea of the principle on which the machine is constructed, than this concise notice.

Observations.—It would seem from this paper that the machine described in it has not as yet any other existence than in the brain of the *anonymous* communicator; for not a word is mentioned of

its having ever been used, or even made. The hint, however, of combining the drill and the roller in one implement is deserving the attention of agriculturists, and may be applied to many useful purposes. The suggestion that the drill part may be so made as to be removed from the frame occasionally when the roller only is wanted, is also deserving of remembrance; and though one particular kind of drill is mentioned in the description, yet every kind may be adopted in a similar way with equal convenience.

On an Improvement of the common Seed-lip or Basket. By an Essex Farmer.—Dickson's Agricultural Magazine, No. 6.

THIS improvement consists in using a seed-basket, with a wire bottom, made like a screen, to which a bag is attached; so that the seeds of weeds, and all small corns, may be riddled through the screen-bottom into the bag by the agitation produced during the operation of sowing. This improvement is stated to have been first adopted by an ingenious farmer in the neighbourhood of Malden.

Observations.—The simplicity of this contrivance, and the unostentatious manner of its announcement to the public, will not place it beneath the notice of the sagacious agriculturist: he will be duly sensible of the importance of every thing which tends to lessen the production of weeds, and will lose no time in availing himself of the opportunity of intercepting the seeds of them, by affixing a screen-bottom with a bag to his usual seed-basket.

On Wheel-carriages used in Husbandry. By ARATOR *—Dickson's Agricultural Magazine, No. 6.*

On the Tires of Wheels for heavy Carriages. By PHILARATOR. *—Dickson's Agricultural Magazine, No. 7.*

Remarks on the Height of Wheels, and on Waggons or other Wheel-carriages used in Husbandry. By G. B.*—Dickson's Agricultural Magazine, No.* 8.

THESE three articles on the same subject not being thought of sufficient importance to be separately considered, are classed together under one head. They contain much discussion on the most beneficial shape and height of wheels, but afford little new information beyond what may be seen in the Reports of a Committee of the House of Commons on the subject of broad wheels, which were inserted in the Repertory of Arts, and were noticed in the tenth number of this work. We consider these Reports as the

best collection of information on this subject, and the Parliament now sitting seem to hold the same opinion; for the House of Commons has ordered them to be reprinted in the present session for the use of the members.

In the second of these articles, however, a new suggestion is started; it is there asserted, that benefit would arise from the tires of wheel-carriages being made concave; inasmuch as, in that case, they would not displace the materials so much in bad roads as dished wheels, and, by bearing on the edges in good roads, would considerably lessen the friction. And, in the third article, it is recommended to make the hind wheels of waggons *lower* than the fore wheels: the reason assigned for it is, that the axle of the hind wheels would then be more in the line of draft; but we do not conceive the case to be made out by the reasoning. All the three articles are anonymous; and two of them appear to be written for the purpose of controverting positions laid down in preceding numbers of the Magazine, rather than with a view of making public any new discovery or improvement.

On a polled Merino Ram, &c. By Sir GEORGE STUART MACKENZIE.—*Dickson's Agricultural Magazine, No. 7.*
On a Ram of the Merino or Spanish Breed without Horns. By a Norfolk Farmer.—Dickson's Agricultural Magazine, No. 7.

IT having been doubted by a former correspondent of the Magazine, whether or not a ram of this breed ever existed without horns, Sir George Mackenzie relates, in the first of these papers, that he purchased one without horns from His Majesty's flock, which is a very fine animal of the kind; and it is stated in the latter, that Mr. Tollet, of Staffordshire, produced one without horns at the Holkham sheep-shearing of 1806, which is believed to be still in the possession of Thomas William Coke, Esquire.

On the Means of removing the Effects of the Bite of the Adder. By W. N.—*Dickson's Agricultural Magazine, No. 7.*

As many farms are infested with this poisonous reptile, which affords a remedy for its own bite more efficacious than any medicine, the writer conceived he should be usefully employed in pointing out the means of removing the effect of the bite; the success of which he had four times experienced in its application to a pointer, which had been stung by the venomous reptile. The mode of cure recommended by him is, to procure as many adders as possible in the month of May, and to take the fat from them, and simmer this fat over the fire to extract the oil (which at that

time they yield in the greatest plenty), and to preserve the same in a phial for use. When any animal is stung by the adder, he advises opening several places, in the swelled parts, with a phleme, to discharge the corrupted blood, and then to moisten the wound several times with the viper's oil, till the swellings begin to decrease; when it should be healed by the application of an ointment composed of half a pound of pork suet, half a pound of turpentine, half a quarter of a pint of oil of turpentine, two ounces of linseed oil, two ounces of bees' wax, two ounces of rosin, and three table-spoonfuls of honey, which are to be boiled well together, and strained through a piece of crape; and half an ounce of powdered verdigrise to be stirred in till the whole becomes cool. It is added, that this ointment is also extremely serviceable among horses for collar and saddle chafes, as well as for kicks, cuts, &c.

Observation.—The remedy here recommended for the curing the venomous bite of the adder, is in unison with the opinion of the most experienced medical men on the subject, and ought to be always kept in readiness in those parts where this noxious reptile abounds. The ointment is well calculated for all wounds from whatever cause produced.

Description of a new-invented Instrument for sowing under Furrow, and for giving a slight Stirring to the Soil, so as to form an excellent Seed-bed, &c. &c. By P.—*Dickson's Agricultural Magazine, No. 7.*

This machine consists of a common roller, having a broad three-inch plank fastened to the frame about eighteen inches before the roller. In this plank are fixed a number of small shares, placed in a line from side to side, each of which, being made long in the shape of a mould-board, turns over in its progress a narrow furrow; and the surface is again levelled by the pressure of the roller. If the corn be sown broad-cast before the machine, the shares will turn the clods over it, and the roller render the whole firm and neat.

Observation.—This implement does not appear to have been ever applied to practice, but to be a mere untried contrivance of the same gentleman who communicated the description of a sowing roller in the preceding number of the Magazine. The principle of both implements is the same, and they may answer in light soils in high cultivation, but cannot be applied to stiff clay or loam.

On the Use of the Seed of the great Sun-flower (Helianthus annuus) as a Food for Swine, Rabbits, Poultry, &c. By Mr. JOHN SAUNDERS, *of Stroud, Gloucestershire.—Dickson's Agricultural Magazine, No. 6.*

THE writer observes, that, in order to provide a sufficiency of food for the increasing population of the kingdom, the exertions of the agriculturist should not be confined to obtaining the utmost produce from crops already known and in common use, but that his researches should lead him to investigate all the numerous tribes of the vegetable kingdom; and, from increasing experiments, should endeavour to explore and call into action the various hitherto unknown or hidden sources of subsistence. Impelled by considerations of this nature, Mr. Saunders commenced a series of observations and experiments on the sun-flower, and he exults in having "the good fortune, by giving the subject a close attention, to discover a new food for swine, and of the corn kind, which is also excellent for tame rabbits, poultry, horses, &c." (and he supposes also for working and fattening oxen and cows). The produce of this plant, so commonly cultivated for ornament in our gardens, is stated to be very great indeed; he reckons that an acre will produce from fifty to sixty sacks; and supports his conclusion by the following calculation. He conceives a grain of sun-flower seed to be twice the size of a grain of wheat; and, according to a calculation in a former number of the Agricultural Magazine (No. 16, Old Series, for November 1800), in this proportion there will be 308,000 seeds to a bushel; allowing every plant to produce 5000 grains on an average, and to occupy three square feet of land, the produce per acre will be according to this statement: the profit, even at the low price of two shillings and sixpence for each sack, is estimated at four pounds for an acre. It is observed, that a peculiar advantage of cultivating the sun-flower plant upon a large scale, would be, that it will yield vast crops upon the poorest soils, and without, in any great degree, impoverishing the land; which is shewn in the spontaneous production of the plants from shed seed, and in their perpetual succession in many gardens, where frequently they do not receive a particle of manure, and yet are produced, one year after another, in equal size and perfection.

The writer next remarks that it is not to the seed alone that the attention ought to be confined, for that it yields other returns of importance: he observes that it is an annual which, in the last stage of vegetation, assumes more the appearance of a shrub or young tree, than that of a flower; as the stalks frequently mea-

sure from four to eight feet in height, and from two to six inches in circumference, and these stems partake so much of the nature of wood, that, when perfectly dry, they may be burnt as fuel, and afford an excellent substitute for chips to light fires, and occasionally to make the pot and kettle boil. The value of the stem, in this point of view, is said to be very considerable, as an acre would produce from three to nine waggon-loads of this fuel. It is also suggested that they might, by wattling and other modes, be made to enclose sheep, and to guard them from the inclemencies of the weather; and that, where there are dry walls, with the aid of rafters and hurdles, they might be converted into an excellent covering for temporary sheds in the fields, and about the homesteads, for pigs and other animals to lie under. The leaves of the sun-flower, which are very numerous, are likewise recommended as an excellent green food for rabbits, if gathered from the stalk, or might serve them for litter, if dried when the plant is pulled up. The convenience attending a crop of sun-flower plants is not forgotten to be mentioned; for they will remain a long time after they are ripe without shedding their seeds through neglect of gathering; and are not liable to be injured by rains, or destroyed by the attacks of birds.

Mr. Saunders admits, that he has made but few experiments in the use of sun-flower seeds as a food for animals; but that whenever he has given them to rabbits, they were eaten at first without dislike, but afterwards with the greatest eagerness, and a decided preference to bran; and he considers it worthy of remark, that rabbits will reduce the seed to the fineness of powder, by nibbling them with their teeth; and that they consume the leaves with avidity. He gave some to a neighbour's horse, first mixed with bran, and afterwards alone, and the horse ate them like corn; the same effect was also produced by giving them both to pigs and poultry. He concludes his long encomium on this plant by asserting that he has been credibly informed that in France they actually cultivate the sun-flower in the fields, for the sole purpose of extracting an oil; and that a friend of his cultivates the seed as a food for partridges, pheasants, pigeons, and other birds, from a conviction that they fatten them in a superior manner to any other species of corn; and this friend has assured him that bees resort to the flowers in a remarkable degree. It is recommended to sow the seeds very early in the spring, if not in December, as the early sown plants always arrive at the greatest height, and produce the largest quantity of seeds.

Observations.—From the very long series of uses to which this gentleman recommends the sun-flower to be applied, we confess ourselves disappointed in not finding among the number a recommendation to grind the seed and make the flower into bread, espe-

cially in times of scarcity; for the plant seems to be so great a favourite with him, as to be spoken of with all the warmth of affection usually bestowed by an inconsiderate parent on an only child, who is too frequently supposed to possess every virtue, and to be free from every vice. Though the sun-flower cannot be considered, if the inquiry be conducted with impartiality, as deserving all the high encomiums bestowed upon it by Mr. Saunders, in an elaborate and enthusiastic essay of more than twenty octavo pages, yet this paper certainly contains many useful and even valuable hints, which may be improved by the judicious reasoner. The seed is of a warm nature, and is well fitted to be given to rabbits, with green food to correct the acidity of the latter, and a portion of it may be usefully employed among other food in fattening pigs and poultry, particularly among potatoes; but its heating qualities forbid it to be given alone, except to pigeons, and birds of wing, who can correct its effects by searching for food of a contrary nature.

Remarks on Mr. Saunders's Letter "on the Use of the great Sun-flower" (the preceding Paper). By AMICUS.—*Dickson's Agricultural Magazine, No. 7.*

THIS writer states it to have been his intention to have communicated many uses to which the sun-flower seed might have been applied, particularly the feeding pigs and poultry, had he not been forestalled by the communication of Mr. Saunders, published in the preceding number. He adds, however, the description and mode of culture from Dr. Willick, and the Gardener's Calendar of Mawe and Abercrombie. With regard to the value of the oil to be expressed from sun-flower seed, he states that, being in the East Indies about twelve or thirteen years ago, he employed a surveyor, who was in the habit of engraving and printing his own works. This artist having complained to him of his inability to procure some sun-flower oil, which he expressed a great desire to obtain, as it was in much use among the printers in America, he availed himself of an opportunity of cultivating some as a screen to hide a mud wall; and having expressed the oil, he sent some to his friend the engraver, who returned him some printing, in which it was used in 1798, which he still possesses, and which he asserts is a sufficient proof of the good character given to the oil of sun-flower seed. He gave the cake, after the expression of the oil, to a pair of small oxen, who eat it greedily, and throve well upon the small quantity of two pounds a day. He states the oil to be as fine transparent sweet oil as ever was produced from almonds, and that eighty pounds weight of the clean seed produced eight quarts of oil; part of it he used in lamps, and found it burn with great pureness and brilliancy.

Observation.—The uses for which the sun-flower may be advantageously cultivated, are clearly ascertained by the experiments detailed in this paper, which convey more information as to the real value of the plant than could be gleaned from a volume of the enthusiastic reveries of Mr. Saunders. If the oil of sun-flower can be applied to many of the uses for which the oil of almonds is imported (and it appears from this paper that it may), the cultivation of the plant becomes a matter of high importance in our present restricted intercourse with the Continent; and it is to be wished that its real merits were decidedly ascertained by repeated and varied experiments.

On new Articles of Cattle Food, Pigs, Poultry, Bees, &c. By Cultivator Middlesexiensis.—*Dickson's Agricultural Magazine, No.* 8.

This paper, though with a different title, may with much propriety be placed under the same general head, as it is rather a critique on the two preceding articles than a communication corresponding with its title. Without discommending the rhapsodies of Mr. Saunders in praise of the sun-flower, the writer remarks, that its uses are not recommended on the ground of experiments, but as the mere flights of imagination, which are to be received with great caution. He remarks that pigs *may* be fattened upon clover and lucern; upon potatoes, oil-cake, and butcher's offal; but that pork, fed on the artificial grasses, is both of a bad colour and flavour; on potatoes, light and insipid, the fat running away in cookery; on oleous articles, or offal, of a rank and offensive smell. It is stated as his opinion, that, calculating the superior weight given to the carcase, as well as substance and nutritive quality to the pork, or bacon, it is extremely probable that the best articles of food are also the cheapest, and that the mixtures on which some feeders so much congratulate themselves, are at best but a mixture of deception.—"The analogy," he observes, "holds precisely with respect to horses; you may fatten them, and give them the semblance of ability to labour, with grass, carrots, turnips, oil-cake, or hay, but you will obtain the perfect ability itself from corn alone." He agrees with Mr. Saunders in the mode of cultivating the sun-flower, and its harvesting and preservation, but thinks the magnificent produce promised by that gentleman to be nothing more than an agricultural *hoax*.

Observations.—This paper contains a variety of judicious remarks, in many of which we perfectly coincide. The author truly observes, that the culture of the sun-flower is not now recommended for the first time, and mentions its having been sown in the fens for the sake of the oil. The observations, which more

immediately apply to Mr. Saunders, border more upon harshness than we can approve, though we are not disposed to give implicit credit ourselves to all he says in praise of his favourite flower. The perusal of this paper should not be omitted by those who read the two preceding ones.

On the Improvement of Wheels, under the Title of Patent Box Nave, effected by Mr. PLUCKNETT.—*Dickson's Agricultural Magazine, No. 6.*

THE improvement alluded to consists in lessening the friction of the nave against the axle of the wheel, by the introduction of small friction wheels fixed to the nave or axle; by which practice the attrition, or rubbing, is transferred from the circumference of those interior wheels to their pivots, or the several centres round which they revolve, on a principle exactly similar to that which is had recourse to in the common pulley, which is found to afford less resistance when turning upon its axis than when in a fixed state. The patent for this improvement was obtained by a Mr. Brown, of Poole, in Dorsetshire. Mr. Plucknett has attempted to obtain the same diminution of friction, by forming the inner surface of the box so as to consist of eight, or any certain number of sides or angles, instead of being one continued cylindrical smooth surface, as is mostly the case, so that the friction is wholly confined to these angles; and he also conceives, that the retention of grease is much more perfectly preserved in consequence of the hollows between the angles of the octagon.

Observation.—This improvement of Mr. Plucknett, for diminishing the friction of wheels, is certainly ingenious, and does credit to his inventive powers; but if it be considered in a continuance of application till the wheel be worn out, it appears more specious than solid.

On the proper Management in breaking up and cropping old Meadow or other Grass Lands. By a working Berkshire Farmer.—Dickson's Agricultural Magazine, No. 7.

THIS communication is avowedly made in reply to a query respecting the best mode of converting old meadow and pasture land into arable, which had appeared in a preceding Magazine. This writer gives his account not as the *best* method absolutely, but as one which he had found very advantageous. He ploughed the land deep, in the month of November, in small furrows, not more than nine inches; the turf turned over well, and it lay in

this state till the middle of March. He then drilled Tartarian oats, drilling them with the hand the same way as the furrow, after the rate of six bushels to the acre, and women and children followed with hoes, covering in the seed, and keeping every bit of turf down under the soil; and in covering the first row, they trod well the furrow slice, where the next row was to be, before the seedsman followed to strew the seed. By this plan the turf was completely reversed, not a crevice was left for the grub to work in (for they will not work near the surface for fear of rooks and other birds), and the oats were not buried more than from one to two inches deep. The appearance of the ground, when completed, is asserted to be that of a perfect fallow, with not a bit of grass to be seen; and a boy followed in the afternoon, and rolled with a one-horse roller, what had been planted in the day. The land is stated to have been of a middling quality, and rather springy. A particular account of the produce, which was abundant, is promised in a future Magazine.

Observations.—There are two circumstances in this paper which manifest the knowledge of a master in the art of agriculture;—the care bestowed to keep every bit of grass beneath the surface (for it will not vegetate without light);—and rolling the surface too firmly for the grub to penetrate in the first instance. The grub is a serious and very destructive enemy, if he once gets into newly broken up grass land, as he frequently destroys half the plant. Though this writer styles himself "a working farmer," yet his knowledge is more truly valuable than that of a whole society of mere theorists.

On grafting the Vine on the Elder Tree. By a Friend to Improvement.—Dickson's Agricultural Magazine, No. 7.

The writer observes how generally it has been regretted that the vine should be so many years before it bears a crop, and that it should only be applicable to particular aspects; and states, that, in his opinion, the most probable means of giving earlier bearing, earlier maturity, and more general culture to that valuable production depend on grafting; but much difficulty appeared to him in regard to the stock on which it should be matriculated, both because it should be a standard, and like itself produce cluster fruit, while its stem and branches should be somewhat hollow and pithy. He conceives all these points to be concentred in the elder, which is extremely resemblant in all the properties above mentioned; and recommends a trial of the experiment, with a full assurance of a favourable result.

Observation.—The suggestion conveyed in this paper is not unworthy the notice of the horticulturist, as the analogy between the vine and the elder is not more dissimilar than that between many plants which are propagated by grafting. In attempting the experiment, care should be taken to insert several scions in the stock, that the branches may extend in various directions.

On the bad Effects of the present Mode of hooking the leading Horses to the Shafts of Waggons, Carts, &c. By P.—*Dickson's Agricultural Magazine, No. 7.*

The inconvenience which is stated to arise from hooking the leading horses of carts and waggons to the end of the shaft, as is the usual practice, is, that, on reaching the top of ascending ground, the power of the leading horses oppresses the thill-horse, inasmuch as the exertion of that power, to obtain a point of draft in a line with the axis of the carriage, nearly bears down the thill-horse, whose back in this case becomes a fulcrum, on which the strength of all the preceding horses acts as a lever. To remedy this inconvenience, it is recommended to let a looped iron, of about a foot in depth (over all), be fastened to the shaft, near the end, nailing or rivetting it firmly by means of expanded flats on the sides of the shaft. The loop would reach about eight or nine inches below the shaft; and if the trace be carried through this loop, instead of being hooked there, and be made long enough to hook the bottom of the shaft, near where it is fastened to the frame of the carriage, the power of draft would be equally advantageous, and the pressure on the thill-horse, in gaining ascents, would be avoided.

Observation.—This simple and easy method of avoiding a long-acknowledged evil, will probably be as generally adopted as it is known and considered: it is much preferable to putting the traces through a ring at the *top* or *side* of the shaft, as is commonly practised in the midland counties, though not so much on a principle of removing pressure from the thill-horse, as of preventing the traces from unhooking.

On destroying Insects injurious to Cultivation. By Joseph Hume, *Esq.—Phil. Mag. No. 116.*

On the Use of Sulphur as a Vermifuge. By Joseph Hume, *Esq. —Phil. Mag. No. 117.*

In the first of these papers Mr. Hume observes, sublimed sulphur (flowers of sulphur), not crude brimstone in powder, is a

very simple cure for the ravages occasioned by insects, and particularly by the aphides or plant lice.

In the second paper, Mr. Hume says, the method of applying the sulphur is to sprinkle it over the leaves of the plants, which may be effected either by tying it up in a piece of muslin or linen, and using the bag as a duster; or it may be thrown on by means of a swandown puff, or even a dredging-box.

He finds that sulphur is *congenial* (we suppose he means conducive) to the health of plants; and that peach-trees absorbed it, and *were even fond of it.* Independently of the deleterious effects of flowers of sulphur on the vermin, the *sanative* (salubrious) power of such an insoluble substance seems of the utmost importance, and must be highly interesting.

The first experiments were made in East Lothian, in Scotland.

Observations.—Were it not beneath the dignity of our Journal, a fund of satire would present itself to us, in the idea of a Scotch chemist, in London, recommending the application of sulphur to kill vermin, and that it is practised in Scotland; but we wave such illiberal reflections, and only observe, that as chamber-ley, in which tobacco has been soaked, is equally efficacious and certainly more economical, there is no necessity for recurring to any other remedy; especially as the proposer informs us that it is the genuine flowers of sulphur, not powdered sulphur, that must be used; but as the latter is now almost universally sold under both names, the communication appears to be merely an advertisement to bring customers to the shop of Joseph Hume—Esquire, chemist, Long Acre.

An Essay on the Nature, Produce, Origin, and Extension, of the Merino Breed of Sheep. By Caleb Hillar Parry, *M. D. F. R. S. &c.—Communications to the Board of Agriculture, Vol. V. Part II.*

The Board of Agriculture having offered a premium for "The best essay on the growth of wool from the Spanish breed of sheep, or from some cross between the Spanish and British breeds in Great Britain, which shall include a detail of experiments made, with a full explanation of the advantages which may have attended them in respect of wool, carcase, application of food, freedom from distempers, cross in the breed, &c. and which shall point out the most effective means of spreading this race of sheep;" the premium was adjudged to Dr. Parry for the present Essay.

The author prefaces his subject by observing, that he is indebted to many foreign publications for the greater part of the

history of the Merino breed of sheep, and acknowledges his obligations to the writings of Bourgoanne, Pictet, and Lasteyrie, in particular; and he states, that by means of an apparatus obtained from Messrs. Jones, the opticians, he has been able to make a very accurate admeasurement of many specimens of wool, the result of which he has thrown into a supplement, annexed to the treatise.

That the importance of the question, submitted by the Board, may be more fully estimated, he has devoted one chapter to the quantity and value of superfine wool imported into England from foreign countries. That the quantity may be ascertained from undoubted authority, he has availed himself of an account presented to Parliament, of wool purchased in foreign countries in 1802, 1803, and 1804. In these three years were imported from Spain 16,986,644lbs. from Holland 403,400lbs. from Portugal 400,723lbs. from Gibraltar 288,274lbs. from France 252,222lbs. from Germany 122,150lbs. from America 10,567lbs. from Prussia 3,357lbs. and from Denmark 381lbs. making a total of nearly 18 millions and a half of pounds, of which nearly 15 millions and a half were imported in Spanish or neutral vessels, and the remainder in English vessels. His inquiries among the clothiers have enabled him to state the value of this quantity to be as follows:

	lbs.		£.
Sheep's wool, marked R (finest sort)	12,000,000,	at 6*s.*	3,600,000
Ditto, marked F (second sort)	2,000,000,	at 5*s.*	500,000
Ditto, marked T (third sort)	1,127,020,	at 4*s.* 6*d.*	253,579
Ditto, marked K (fourth sort)	14,920,	at 3*s.*	2,238
Lamb's wool	165,778,	at 4*s.* 3*d.*	35,227
In foreign vessels	quantity 15,307,718lbs.	value	£4,391,044
In English vessels	quantity 3,160,000lbs.	value according to the same proportions, for it could not be ascertained	£906,419

These accounts give the annual average of Spanish wool imported as exceeding 6,155,906 lbs. weight, and the annual average value as upwards of £1,560,000 sterling.

In the next succeeding chapter he proceeds to describe the Merino breed of sheep, which produce this valuable article of importation. Their native country is Spain: the number of them in that country is about five millions: they are divided into two sorts, those which travel from one part of the country to another, which are called "Trashumantes;" and those which remain always in the same pastures, named "Estantes." The animal is described below the middle size, in comparison with English breeds, not very unlike the Ryeland, or old Southdown breed, and by no means furnished with that form, which modern fashion

has presumed to be inseparably connected with a disposition to early maturity and fatness. And though individuals differ much in these respects, yet the Merino sheep have generally their heads large and their necks long, their chests contracted, and being sharp on the shoulders and flat-sided, and narrow across the loins. Against these defects, however, are to be adduced the peculiar quality of the skin, which is remarkably thin, soft, and loose, affording that evidence of a strong disposition to fatten, which many of our farmers call proof: the skin also differs from that of the native sheep of Britain, in being of a fairer hue, with a vivid tint of what is called carnation, or flesh colour, which tint is particularly conspicuous on those parts which are free from wool, as the eyelids and lips. With this peculiar condition of the skin he considers to be connected the peculiar characteristic of the Merino race; namely—its fineness and flexibility; in which the Merino is superior to every other race of sheep in the world. This breed is literally buried in wool; it exists on their foreheads almost to the eyes, and on the cheeks, and entirely covers their bellies and legs. The length of the staple or filaments of the wool is from two to more than three inches; the wool of the ram coarsest and longest, of the ewe finest and shortest; of the wedder, in both respects, between the two former.

It is stated from the publication of M. Lasteyrie, that the average weight of the fleece, unwashed, is about 5lbs. 7oz. English weight; but in the Compte rendu à la Classe des Sciences of Paris for 1802, 30 fleeces, recently imported, are said to have weighed, unwashed, 99 kilogrammes and a half, which is equal to 7lb. 5½oz. English, for the weight of each. This wool, however, was of thirteen months growth. Dr. Parry considers the weight, quoted from Lasteyrie, to be equal to the average of ewes' fleeces, and that it is probable the medium weight of rams' fleeces, in Spain, does not exceed seven pounds; though there is certainly great difference in the weight of particular fleeces.

The principal Merino flocks are then enumerated, both those belonging to the grandees and to the different societies of monks, which compose the corporation of the Mesta. The size of the Nigrette is stated to be superior; but it is said that the race of the Escurial is supposed to have the finest wool of all.

The difference between different flocks of Merino sheep, in Spain, and between different individuals of the same flock, is referred to the proportion of the grease, or yolk, which imbues all wool, but pre-eminently that of the Merino. From its superabundance in this particular breed, the fleece contracts, near its surface, a quantity of dust, earth, and other matters, so as to give the animal a dirty appearance; which usually is most manifest on the finest fleeces, as they contain the greatest quantity of yolk, or grease; but notwithstanding this darkness on the surface, the wool when drawn

asunder, nearer the skin, has a brilliant silky appearance, and, when scoured, is of the purest white.

The fleece is not washed for sale on the sheep's back, but after the wool is sorted; and usually loses three fifths of its weight in the operation, and some authors assert that the loss is often two thirds; and afterwards, in scouring by the clothier, an additional loss is sustained of about three, or three and a half, in twenty; but as the quantity of the yolk is different not only in different individuals, but in the same individual at different seasons, the loss in washing and scouring will proportionally vary.

It is remarked that the yolk of wool, here spoken of, has not escaped the notice of the French chemists: by an analysis of this substance by Vauquelin, published in the Annales de Chimie, it is found to contain a large proportion of fatty matter united with potash, so as to form a natural soap; a smaller quantity of potash, combined partly with carbonic, partly with acetous, and partly with muriatic acid; a little lime, in a state of unknown combination; a small quantity of uncombined fatty substance; and a little animal matter which seems to produce the peculiar waxy smell: this yolk is supposed to be formed from the perspiration of the animal.

The wool of Merino sheep is also said to differ from that of all our native breeds, in being nearly of an equal fineness on the shoulder and the rump, though it grows more thickly on the latter part; and the whole fleece is remarkably free from those coarse hairs, usually styled snitchel hairs, or cats' hairs; and the wool of the lambs is much coarser and harder than that of the sheep. The sheep themselves are longer in coming to maturity than most other breeds; they do not acquire their full growth till three years old, and the ewes rarely take the ram till they are eighteen or twenty months old, though the rams are fit for generation in a year: but the most striking particular in which the Merino race differs from every breed of short-woolled sheep, either in this or other countries, is, that while very few of the rams are polled, or have short snags, the majority have large spiral horns; and on the other hand, a horned Merino ewe is rarely to be found. The rams and ewes form separate flocks, in Spain, till the beginning of July, from whence they are suffered to continue together till the middle of August; one ram is generally allotted to twenty or twenty-five ewes. The ewes seldom produce more than one lamb at a birth, and seldom more than a fourth of these are permitted to be raised; the remainder are killed immediately as they are dropped, and by transferring the skin to another lamb, the mother is induced to adopt it, so that each lamb has two and sometimes three nurses. As the ewe-lambs are mostly preserved, the ram-lambs are but few, and are very rarely castrated: the wedders are rams on whom this operation has been performed at six or seven years of

age, when they are no longer fit for propagation. So little are these sheep considered an article of food, that though immense flocks of them pass through or near Madrid twice every year, the mutton of that capital is supplied from Africa, as the beef and pork are from the neat cattle and pigs of France.

In the winter, the Merino flocks cover the plains of the fertile provinces of Valentia, Murcia, Arragon, Castile, La Mancha, Andalusia, Estremadura, and the neighbourhood of Cadiz; but when the herbage is wasted by the increasing heat of the sun, which generally happens in April or the beginning of May, the flocks commence their journies to the mountains of Leon, Castile, Navarre, Arragon, Segovia, Burgos, the Asturias, and other elevated districts. These journies are conducted with much order, and are minutely described in the Essay. During this journey the shearing takes place: when the weather is fine, the sheep are conducted to the esquileos, or shearing-houses, which are usually on the mountains near the roads; they are kept for a day previous in a sudadeos, or sweating-house, in which they are so crowded as to have scarce room to move, or even to breathe; and though this practice has for its pretended object an increased facility of shearing, yet it is probably meant to augment by perspiration the weight, and consequently the price of the fleece. One with another each man shears fifteen sheep in a day; and if by accident the skin is wounded, they drop on the part a little powdered charcoal to heal the wound and guard it against the fly. When the fleeces are shorn, they are put into a damp warehouse, all the doors and windows of which are closely shut, so as not to admit any transmission of vapour; and this warehouse is not opened till the merchant comes to weigh the fleeces. The Spanish flocks occasionally suffer much from shearing; and that of the Count del Campo Alange is reported to have lost five or six thousand in a single night. The shearing lasts three or four weeks, after which the sheep proceed on their journey, and remain on the mountains till the return of winter, when they are driven back again to the plains. It is customary to give all the sheep in Spain, whether Trashumantes or Estantes, a small quantity of salt, but the former have it only when in the mountains.

The wool in sorting is divided into four parts: the first, which is called by the Spaniards refina, or floreta, and which is marked R, is taken from the flanks, the back as far as the tail, the shoulders, and sides of the neck;—the second, or fina, marked F, comprises the wool of the top of the neck, the haunches as far as the line of the belly, and the belly itself;—the third, tercera, marked T, is that of the jaws, the throat, the breast, the fore-legs to the knees, and the hinder thighs from the line of the belly down to the hocks;—the fourth, or cahidas, marked K or C, is that below the hocks, between the thighs, the tail, the buttocks,

the pole, and behind the ears, and all that which shakes out of the fleece in shearing or in washing. A set of bags, containing the whole of the first three sorts, is called a pile, the proportion of which many years ago was R 15 parts, F 4, and T 1; the profit arising from the sale of the cahidas, or fourth sort, is said to be allotted for the consolation of souls in purgatory. When the wool is sorted its reduced by washing in hot water to the state in which it is imported into this country.

Of the five millions of sheep in Spain, the estantes, or stationary part, are said to be about one tenth; and though there is in Spain, as in England, a prepossession in favour of the effect of travelling on the fleece, which the great proprietors encourage, yet it is asserted, on the authority of Bourgoanne and Lasteyrie, that several of the stationary flocks yield wool equal in excellence to the best of the Trashumantes; in Estremadura and Segovia there are flocks which never travel, the wool of which is not inferior to that of the other sort.

The diseases to which the Merino breed is chiefly subject, in Spain, are said to be the scab, giddiness, and an eruptive infectious disorder, like the small-pox, fortunately unknown in England, and for which we have no name. The Spanish shepherds do not employ any remedies worthy of notice for the cure of these maladies, unless it be of importance to announce, that, when other means fail, they have recourse to magic.

Every thing respecting the maintenance of the flocks of Spain, as well Merinos as others, is directed by a code of laws called the Mesta, which first received the sanction of government about the year 1450.

The author proceeds to state, that he has looked in vain into writers for any plausible explanation of the name Merino, or any authentic history of the origin or introduction of the race itself. By some, he observes, it is attributed to England, and supposed to be derived from the Cotswold breed; but from an inquiry into the quality of English wool, cloth, and sheep, from the earliest times to the latter end of the seventeenth century, which is extended over a considerable number of pages, he is of opinion that the Merino breed was not derived from Britain. It is also given as the opinion of the best informed writers, in which Dr. Parry himself concurs, that they were not originally brought from Africa, though this is strongly maintained by a writer in the French Encyclopedie, who boldly asserts that this race was formed about the time of the Emperor Claudius, from importations of African rams, by Columella, uncle to the celebrated agriculturist of that name. That the Encyclopedist was evidently mistaken is proved by a quotation from the seventh book of Columella's Treatise De Re Rusticâ; it appears, however, that the Roman agriculturist tried many experiments to obtain fine-woolled coloured lambs, by coupling coarse-coloured rams, which he obtained from Africa,

with white fine-woolled ewes; but it does follow from his words (in agros transtulit) that Columella placed those rams on any lands of his in Spain. Dr. Parry thinks it much more probable, even from the words themselves, as well as from the nature of his object, that he brought them into the Roman territories in Italy, where there was abundance of the "oves molles," the "oves tectæ," which were chiefly valued for fine white wool. For among the Romans all ranks of people, of both sexes, wore chiefly woollen garments, a pound of silk, even in the reign of Aurelian, at the close of the third century of the Christian era, being, according to Vopiscus, equal in value to a pound of gold. And when the pre-eminence in wealth, and the prevailing vanity of the Romans are considered, and since the heat of Italy is so great at certain seasons of the year, as scarcely to admit the use of a woollen dress, the Doctor is of opinion, that the quality of the wool must have been a matter especially important, since, during the Augustan age, and for a considerable time afterwards, it was the fashion to wear cloth furnished with a nap or pile. It is recalled to the recollection of the reader, that Varro, Columella, Pliny, Martial, Palladius, Petronius, and Calpurnius Siculus, agree in stating that the sheep which produced the finest wool in the Roman dominions, were those of Apulia and Calabria. A pound avoirdupois of this wool is stated to have cost about 1*l.* 1*s.* 7*d.* of our money. And even at this time, according to Pliny, and some other ancient authors, Spain was not without valuable breeds of sheep, which were memorable for bearing fleeces naturally of different tints. Columella speaks of them as bearing blackish or tawny coloured fleeces; Pliny, who lived somewhat after him, adds, that they were occasionally of a reddish or gold colour, like those of Asia, and Martial compares them with the golden or red hair of women. The opinion of Strabo, with respect to the Portuguese sheep, is then examined, and it is clearly made out, that the wool of them was more like hair, and incapable of being manufactured into cloth with a nap or pile. The historians of Spain, who had been diligently consulted for the purpose, afforded him no information on the subject.

From all these circumstances he concludes, that however the notion of the English origin of the Merino breed of sheep may serve to flatter the national pride, yet that it falls to the ground as soon as it is investigated; and also that it is not more probable that the race was introduced into Spain from Barbary, as asserted by the French Encyclopedists: but, adverting again to the attention which the Romans paid to their sheep, and particularly to the breed, which, from producing the fine short wool, was much valued, and the object of peculiar care on that account, he thinks it probable that the race of short-woolled sheep of the ancient Romans, and the present race of Merino sheep of Spain, are the same. For the perfection of both these breeds, he observes, seems

to have consisted in certain common qualities. "The favourite ewe of ancient Italy was to have a large carcase, capacious belly, short legs; and the ram a wide breast, shoulders and buttocks, a long and deep body, and a broad and long tail. The fleece was to be thick, soft, and deep, especially about the neck and shoulders. It seems to have been with a view to the increase of wool, on this finest part of the animal, that the Romans thought a long neck valuable in the ewes: the ears and forehead of the rams were to be involved in wool, and no individual of either sex was tolerated, of which the wool did not clothe the whole belly. Regard was also had to the horns: it is a memorable circumstance in these sheep, that the rams had generally horns, and the ewes none; still however the polled rams were most esteemed."—"It is impossible for any one who reads this description," says Dr. Parry, "and who is acquainted with the improved Merino race of the present day, not to suspect that they are one and the same breed."

He then proceeds to investigate evidence as to this fact: he observes, that throughout Europe, as far as he knows, there is not any short-woolled breed besides the Merinos existing, except in Italy, of which the males are horned and the females not: that in former times the sheep of Apulia and Calabria had their different summer and winter quarters, the same as the Merinos now have in Spain; it was also the universal practice among the Romans to give salt to their sheep, with a view to promote appetite and thirst, to increase milk, and to improve digestion; and he can hardly believe that this practice, which still subsists in Italy, should from time immemorial have found its way into Spain, and into that country only, except by immediate communication: and as the Spanish flocks are frequently led by goats in the present day, so it appears, from Tibullus, this was a common usage among the Romans. Dogs follow the flocks in Spain as well as in most other countries; they are however not intended, as in England, France, and most other European districts, to assist the shepherd in guiding and regulating the sheep, but are of a strong and fierce kind, serving to guard and protect both against the depredations of robbers and beasts of prey: so also dogs were kept by the Romans for the same purposes, the qualities, uses, and treatment of which are minutely described by Varro and Columella. Many of these instances, it may be said, may have been coincidences of practice, suggested by similarity of circumstances, but could not have been the reason why, in order to avoid variegated fleeces in the offspring, both nations should exclude rams with spotted mouths or tongues from the privilege of breeding; a practice which is stated to have prevailed among the Romans, upon the authority of Varro and Columella, and to be adhered to by the modern Merino shepherds, on the authority of Lasteyrie. A still more remarkable coincidence is noticed, which is the practice of

killing a considerable number of lambs very shortly after they are dropped. This custom prevailed equally with the Romans as it does with the present Spaniards, and precisely from the same motives;—that as the wool only was the valuable produce of the flock, each lamb might acquire more strength by having two nurses.

This agreement then in so many important particulars of form, fleece, constitution, and general treatment, satisfies the author of the Essay beyond all reasonable doubt, that the present Merinos are the same race as the ancient Tarentine sheep of Apulia; yet he can find no evidence of the time when they were first introduced into Spain. For though the union of Italy and Spain first took place under Frederick, king of Arragon and Sicily, about the beginning of the fourteenth century, yet it is not in Arragon that the best Merino sheep are now found; and the author conceives that the circumstances of the history of Spain would rather induce a belief that their introduction took place at a more remote period than 1300: he leans to the idea of their having existed in that country during the dominion of the rich, industrious, and luxurious Moors, if not in still earlier times, when Spain was under subjection to Rome.

Dr. Parry, having thus completed his observations on the nature, produce, and origin of the Merino breed of sheep, concludes the first part of his Essay by remarks on the extension of the race to various parts of the world.

The Swedes are stated to be the first nation in Europe, who imported Merino sheep with a view to naturalize them; though the most northern part of this country is burnt up during a short summer by a sun which never sets for many days, and the whole is desolated by a winter of seven or eight months, during which the ground is covered with uninterrupted snow. Notwithstanding this it is stated, that M. Alstroemer introduced a flock of Merino sheep into Sweden in 1723, and that under his direction the government instituted a school of shepherds in 1739, and granted bounties of 25 per cent. to the sellers of fine and good wool; these, however, were reduced to 15 per cent. in 1781, to 12 per cent. in 1786, and in 1792 were wholly discontinued. The Merino sheep now in Sweden are estimated at 100,000, or about one twenty-fifth part of the sheep of the country, and the wool is in every respect equal to that of Spain; the size of the animal has in many cases degenerated, but the wool produce has proportionally increased; and the Swedes raise at present in their own country nearly as much fine wool as is sufficient for their manufactures. The more attentive cultivators lodge their sheep during the whole year in large airy buildings, the windows of which are always open, and the doors made of hurdles, and they are driven out twice in the day; the daily allowance of food given to each is two English pounds of hay, with an addition of dried

leaves of trees, stalks of the hop, pease-haulm, and oat and barley straw; but many only house them at night for security against the wolf and the lynx. The sheep are allowed salt in damp or rainy weather; and the shearing takes place in July, the sheep having been previously washed: the average weight of well-washed ewes' fleeces is given at full three pounds, and of lambs' fleeces at one pound.

The Danes first carried Merino sheep from Sweden in 1789, a few descendants of which remain; and in 1797 the government of Denmark imported 300 sheep from Spain, from the celebrated breeds of the Escurial, Guadaloupe, Paular, Infantado, Montano, and Negrette: these were placed at Esserum, eight leagues from Copenhagen, and were all alive, except two, eighteen months afterwards, when they were seen by M. Lasteyrie. They are kept in airy houses, and fed with hay, or rye and oat straw cut into chaff; they are fed three times a day with an allowance in the whole of $3\frac{1}{4}$ pounds of dry food, and in warm weather are sent out into enclosed pastures without a shepherd: salt is given them in wet weather, and some persons give them the heads of salt herrings, or the brine which has been used for pickling meat or fish; the lambs are weaned at three months, and are then allowed the best pastures.

Augustus Frederick, Elector of Saxony, introduced Merino sheep into his dominions in 1765: the number was three hundred, divided into four establishments; and at the end of ten years they were found to have had all possible success; the sheep of the pure blood preserving every valuable quality, and the ultimate crosses having wool fully equal to the pure Merinos. The winter food of this race in Saxony consists of hay, lattermath, clover, oat or rye straw, pease-haulm, vetches, &c. which are given twice or thrice in the day in large buildings, but in summer the sheep are only housed at night, and kept from the pastures till the dew is dissipated. Salt is very generally distributed to them by the Saxons, from an idea that it contributes to their health and to the fineness of their fleeces. The lambs fall before March, and are weaned in June; the sheep are washed before shearing in running water two successive days, suffered to dry for two days, and are shorn on the third, which generally takes place in May. Saxony no longer imports Spanish wool; and much of that grown there has been sent for some years to the fairs at Leipsic, and part of it imported into England. It is said to be allowed by manufacturers, who have tried this wool, that it makes cloth superior in softness and fineness to any obtained from the best Spanish piles.

The Merino breed of sheep was first introduced into Prussia by M Finck in 1768, who obtained his original stock from Saxony; but in 1779 he imported three rams and twenty ewes directly from Spain. Though he has carefully maintained the pure race,

yet he has chiefly employed his rams in improving the native breeds. The Count de Magnis also possesses, at Eckersdorff in Silesia, a flock of nine thousand sheep by the Merino cross. His attention has been directed to uniting size with fineness of wool; he has therefore mixed the best Merino rams with the large breed of Hungary, and in this respect has made great progress, one sheep with another giving three pounds of washed wool, on a carcase larger, stronger, and better formed than any other fine-woolled sheep on the Continent. The times of yeaning, and the treatment of these flocks in Prussia and Silesia, are so nearly the same as what prevails in Saxony, as not to deserve a separate notice; most of the farmers in Prussia allow their sheep to go out during the day in the severest weather, and give them dry food during the night. The Count de Magnis gives his sheep corn, but considers it as too expensive; he regards potatoes as equally beneficial with oats, and certainly much cheaper; and during the winter his sheep eat as much salt as they choose.

The war with Austria prevented M. Lasteyrie from visiting that country and some other parts of Germany; the information therefore which Dr. Parry is able to give, concerning their Spanish flocks, is very limited and imperfect. He relates however, from Lasteyrie, that the Empress Queen Maria-Theresa imported Merino sheep from Spain in 1775, and placed them at Mercopoil in Hungary; and that subsequently to that period two other flocks have been brought from Alicant to Trieste; and in 1802 a person was employed by the Emperor to purchase sheep in Spain. In Anspach and Bayreuth attempts are noticed to improve the native sheep by the introduction of Merinos; and in Mecklenburgh, Zell, Brunswick, Baden, and Hanover, this race has been long enough introduced to improve the wool of those countries in a considerable degree.

It is remarked, that few countries appear less adapted to the support of sheep than the rich and marshy soil of Holland; yet in 1789 M. Trent imported from Spain two rams and four ewes, and placed them on an estate between Leyden and the Hague; in 1793 he imported three new rams and four ewes; and in 1802 his flock amounted to one hundred. His rams' fleeces weighed from 10 to 14 pounds, and his ewes' fleeces from 6 to 10 pounds, in an unwashed state. To prove the fineness of his wool, he placed on a piece of black cloth nine specimens of his own wool by the side of the best specimens of superfine Spanish which he could procure, and sent them to a clothier, who pronounced five of M. Trent's specimens to be superior to the superfine Spanish. In 1793 M. Cuperus, near Leyden, also imported some Merinos from Spain into Holland, and his crosses of the native breeds were in 1802 nearly equal to the unmixed Spaniards in fineness of fleece.

Piedmont appears to Dr. Parry to have first obtained the Spa-

nish breed of sheep in 1793, when Prince Masserino chose 150 ewes from the best flocks of Segovia. Notwithstanding the war, which existed at the time, they increased considerably, and many crosses were obtained from the ewes of Germany, Rome, Naples, and Padua. The greater part of the proprietors agreed to form a society, and in 1801 obtained from the government of France, to which Piedmont was then annexed, a grant to improve, under certain conditions, the plains of La Mandria: the laws for the regulation of the flocks of this society are given by M. Lasteyrie. The management of the Merino flocks of Piedmont appears to vary but in few particulars from the modes which have been previously described. The cultivators of the plains of La Mandria drive their flocks to the Alps from the middle of June to the end of October; they are seldom folded except in the mountains, experience having shewn that their dung in the house is more profitable, provided they are supplied with a proper quantity of straw.

"There is, however," says Dr. Parry, "no country in Europe, which of late years has taken so much laudable pains in cultivating the Merino breed of sheep as France." For though it appears that Spanish sheep had been imported into France at an early period, yet the first person who paid any systematic attention to the wools of that country, by this method, is said to have been Daubenton, who in 1776 obtained part of 200 Merinos imported by M. Trudaine, intendant of the finances. The flock of Daubenton is now in the possession of M. Thevenin of Tanlay, and produces wool of the very first quality. In 1786 about 400 Merino sheep were presented by the king of Spain to Louis XVI. but 60 of them died on their journey, and a greater number fell a sacrifice to the febrile disease before mentioned, similar to the small-pox, after their arrival at Rambouillet. This royal present, having been chosen for their form and fleece from various Spanish flocks, differed much both in size and shape; but having been better assorted after their arrival in France, produced a race unlike any of the original breeds, but equal to the best of them in mould and fineness of wool, and superior in weight of carcase and of fleece. A particular account is given of this flock, which was placed under the direction of an agricultural committee at the commencement of the French revolution, who made an annual report to the National Institute on the subject. From the report of the year 1802 it is stated, on the authority of Lasteyrie, that the medium weight of the fleeces of full-grown nursing ewes was about 8 lb. 7 oz.; of the ewes of three years old, which had no lambs, about 9 lb. 13 oz.; of the two-tooth ewes about 10½ lb.; and of the rams of three or four years old about 11 lb. 5¼ oz.: each fleece selling on an average at the price of about 1*l.* 3*s.* 4*d.* sterling. Dr. Parry has seen several specimens of the Rambouillet wool of 1802, and indeed is in possession of some of it; and,

as far as he can judge of their quality by the naked eye, he considers them to be equal to the Ryeland wool of the Spanish piles. It is stated that, by a secret article in the treaty of Basil, the French Directory had stipulated for itself the privilege of purchasing in Spain 1000 ewes and 100 rams in each of the five succeeding years. From the Rambouillet flock many others have been established in France and its dependencies, none of which is said to be more justly entitled to general notice than that of M. C. Pictet, of Geneva, who established a Merino flock in 1800; and besides these pure Spanish flocks, there are many others of a mixed breed, which have originated from experiments made by individuals, the result of which is said to be, that, with due care, the wool in every breed of sheep is capable of arriving at a degree of fineness equal to that of the Merino, and that the effect is produced by constantly crossing with the finest woolled rams, and is generally obtained sooner or later according to the fineness of the fleece of the ewe, but in no breed later than the fourth cross.

From the account which he has given, it appears to the author of the Essay that the Spanish breed of sheep has been much improved in weight, and probably fineness of fleece, and has considerably increased in size, by having been naturalized in France; and he thinks these valuable points have been accomplished in the four following ways: 1. By choosing for breeding the finest and best woolled rams and ewes;—2. By never allowing them to propagate till they have attained their full growth, which, at the earliest, is not till nearly three years of age;—3. By separating the weak from the strong;—4. By giving them good food, and plenty of air and exercise. A particular account of the mode of feeding and treating them is subjoined in illustration of this opinion, which is too extended to be comprised in this analysis.

It is next remarked, on the authority of Count Alexis Orloff, that Merino sheep have been imported into Russia, but no information is given of the result. With respect to this breed at the Cape of Good Hope, some particulars are communicated from the information of Sir George Yonge, who was governor there; and the author having once had a ram of the native Cape breed, speaks from his own knowledge that the wool chiefly consists of long coarse filaments like hair; this has been very much improved by a cross of Merino rams; and Dr. Parry speaks of a specimen of wool from the fourth cross of the native Cape sheep, which he had obtained from Sir George Yonge since his return to England, as having a filament so fine, as that the next cross would produce wool fully equal to good Spanish.

From these Cape Merinos sprung a race of sheep, which were carried from thence in 1797, by Captain M'Arthur, to the English settlement on the coast of New Holland; and a memorial presented by that gentleman to the English government in 1783 is

added, to evince his sanguine expectations that wool might be produced there from the Merinos, which would be superior to Spanish wool, and some samples which he brought over and gave to Mr. Joyce, of Freshford, near Bath, were equal in fineness to any he had ever manufactured.

Though it is admitted that Merino sheep have been at various times imported into Great Britain, yet the plausible tales of the French encyclopedists on this point are shewn to have no foundation in truth; and the sheep of this breed, which have been imported in modern times, are believed to be very few, till the King obtained some Merino sheep in 1792; in which year he purchased five rams and thirty-five ewes from the flock of the Countess del Campo Alange, which is called Negrette. The management and distribution of this flock through the country by periodical sales, are then amply detailed; but these are circumstances too generally known to make their insertion necessary in this place. The most ample information of the progress of the royal Merino flock of England, may be obtained from the Reports of Sir Joseph Banks, under whose care the flock is placed, and through whose judicious management, it is asserted, the farm has been considerably improved, and the fleece rendered finer than the Negrette pile, the wool of the parent stock in Spain.

The exertions of Lord Somerville to introduce Merino sheep are next noticed, with appropriate commendations of his judgment and zealous activity in all agricultural pursuits; and he is said to have treated his flock so successfully, that the cloth manufactured from his wool is superior to the greater part of that manufactured from Spanish, and the carcase at the same time is fast approaching to best Ryelands or South-downs. The Merino flocks of Lord Portchester and Mr. Tollet, which have been formed from those of the King and Lord Somerville, are also mentioned; and it is added, that, besides these larger flocks, there are in the kingdom many smaller ones of Merino sheep, which the author cannot particularize; but it appears to him that the principal mode in which the utility of the Merino race has been extended in England, has been by crossing our native breeds with Merino rams. The cross with Ryeland ewes is supposed to be that most frequently resorted to, and several gentlemen are named, who are zealously employed in promoting the cross with the Ryeland, the South-down, and the Wiltshire breeds.

The nobility and gentry of Ireland are stated to be engaged in an attempt to introduce the Merino race of sheep into that country. In 1804 premiums were offered for both sheep and wool, to be exhibited at the great cattle fair at Ballinasloe. For the premiums for Merino sheep there was that year no claimant; but the premium of 20*l.* for the best ram's fleece grown in Ireland, was obtained by the Earl of Farnham, for a Merino-Ryeland fleece.

Husbandry on the Broad-way Hills, Gloucestershire. By ARTHUR YOUNG, *Esq.—Annals of Agriculture, No. 266.*

THE soil of this district is described to be either limestone brash, mortar earth, or strong black clay; the first of which is valued at ten shillings an acre, the mortar earth at half as much, and the clay at twelve shillings and sixpence; but Mr. Young asserts that a fairer estimate would raise them considerably. The course of husbandry most commonly adopted is, 1. Turnips;—2. Barley or oats;—3. Seeds; viz. broad clover 6lb. white clover 2lb. trefoil 2lb. and rye-grass 1½ to two bushels per acre; mown once;—4 and 5. The same seeds;—6. The same seeds pared and burnt for —7. Wheat;—8. Oats. Turnips are very generally cultivated throughout the whole district, and the Swedish kind is sometimes sown as well as borecole. Some farmers plough twice for barley, though with many one ploughing only is given; four bushels are sown to the acre, and the grass seeds are also sown immediately after, and the ground is rolled. The preparation for oats is to plough the stubbles in October, leave them till about Christmas, then plough again, and, in the beginning of March, without further ploughing, drag the land, and drill in the seed. When tares are cultivated, they are sown after grass seeds, and eaten off preparatory to the wheat crop; and sainfoin is sometimes sown with barley or oats after turnips; this is usually mown, but does not last above five or six years. The manure is all laid on for turnips; it lies all summer in the farm-yard from the preceding winter untouched, and is carted out in the autumn to heaps in the field. The sheep in this district are seldom folded; the new Leicester breed does not answer on account of the extreme bleakness of the hills; though they succeed better if crossed with the Cotswold breed. The agriculture is mostly performed by oxen in harness, though some farmers use horses also. The farms are generally from four hundred to six hundred acres in extent.

Observations.—This article by Arthur Young, the only one bearing the mark of originality in the last number of his Annals, except some trifling remarks on a flock of sheep, contains very little information;—much less than might have been collected from an hour's reading of Ruggle's View of the Agriculture of Gloucestershire. The Annals have long since been curtailed from a monthly to a quarterly publication, and if they continue to be remarkable only for the same barrenness of information which they have for a long time afforded, the termination of their existence will not be accompanied by one single sigh either in the literary or the agricultural world.

Report of a Committee of the House of Commons on the Cultivation of Hemp and Flax.—Repertory of Arts, &c. New Series, No. 69.

The Committee who made this Report were appointed as long since as 1802, to consider the acts relative to the linen manufacture of Ireland; but the Report has been recently noticed on account of the importance of the subject in the present state of trade between Great Britain and the Continent of Europe. The regulations adopted by the Irish Parliament to prevent the sowing of bad seed, are particularly detailed, the principle of which consists in the appointment of inspectors, who were bound by an oath to examine and give full and true judgment in respect to the soundness and quality of all hemp-seed and flax-seed produced to them, and who were empowered and directed to mark near the bung-hole every cask containing the same, and no bounty was paid to any importer of hemp-seed or flax-seed, which had not been first inspected, and its goodness certified by the mark. And after the repeal of the bounties, it was enacted that whenever the inspectors should be summoned by the officer of customs to examine any hemp or flax seeds, and should not report the same to be of sound quality, or fit for sowing, the seed, with the casks in which it was contained, were to be detained in the king's stores till the first day of July next following the importation thereof, and then delivered to the importer, on his giving bond to export the same, or make it into oil before the first day of February following; and in default of the importer giving such security within three months, the seed is directed to be burned. By an act of 1797, the Inspector-general, or any other officer acting under the Linen Board, is permitted to examine, as often as he shall think necessary, any cask containing flax-seed or hemp-seed, though the same should have been branded or marked by the inspectors, and, in case the seed be found to be unsound, damaged, or unfit for sowing, to require security to be given that the same shall not be sown or sold for sowing, but be made up into oil, or exported from the kingdom.

Observations.—The regulations to prevent the sowing of imperfect or damaged flax-seed, which are detailed in this Report, and are in common use in Ireland, may be advantageously extended to England, if the culture of hemp and flax obtains extensively on this side the Channel. If, however, new laws are deemed necessary on this subject, it is of importance that a clause should be introduced prohibiting the exportation of damaged flax-seed from one part of the united kingdom to the other; as several frauds of this kind were practised with impunity between Scotland

and Ireland in the year 1798, notwithstanding the active interference of the then Secretary of State to prevent the circumstance; but the mischief was done before the official correspondence could be completed.

On a new Method of cultivating, managing, and, in some Degree, of applying Turnip Crops as a Food for Animals, &c. By Mr. John Saunders, *of Stroud.—Dickson's Agricultural Magazine, No.* 8.

The new method, which is stated to have succeeded on a small scale with *rabbits*, and on a more extensive one with swine, and to be here laid down *for the first time*, consists in hoeing out the turnips in the first instance to six inches distance only, and afterwards gradually and regularly thinning them by hand to the distance of a foot between each, instead of finally hoeing them out to the whole distance at first; and in casting away the turnips which are drawn at the subsequent thinning to store cattle on the farm, or store pigs, or *rabbits*, instead of suffering them to perish on the ground. "The pigs and the rabbits," he observes, "will thrive and fatten upon them, provided a liberal allowance of *sun-flower* seeds be daily added to this green food. And where the farmer has recourse to *hay-tea* and potatoes for maintaining his store pigs, he will find a vast advantage in occasionally subsisting them upon turnip greens, not only as saving his hay and potatoes, *but as keeping their bodies open.*"

Observations.—This paper, which contains nothing more than what is comprised above, about the *new* method of cultivating turnips, is spun out to the extent of twenty pages, by irrelevant observations on *rabbits*, and *sun-flower seed*, and *pigs*, and by remarks on Pliny and Elian, and Mr. Bakewell, and by some affectation of benevolence and humanity, but contains nothing else worthy of notice, except what is extracted from other writers. It is very seriously remarked in a note, as *important* information, by this encomiast of hay-tea, of sun-flower seeds, and rabbits, that these beloved animals are subject to the rot, and that the rot is occasioned by their eating too much succulent food!! To treat this paper, however, with the same seriousness as he treats the rot in rabbits, we unequivocally allow him all the merit of the discovery, which he claims, of the advantages resulting from administering turnip-tops to pigs and rabbits as a periodical cathartic.

The Plan of a convenient Harvest and Dung Cart, which has for some Time been much employed in Bedfordshire. By S.—*Dickson's Agricultural Magazine, No.* 8.

The implement here described is nothing else than a common light dung-cart, with sloping side-boards, a copse, and hind-ladder,

to be attached in harvest: an implement too well known to need a description, and too universally adopted to render any recommendation necessary.

On the different Kinds of Sickles and Reaping-hooks employed in Harvest-work. By J. H—N.—*Dickson's Agricultural Magazine, No.* 8.

THE four kinds of this implement are—1. The sickle; a kind of semicircular piece of wrought iron or steel from twenty to thirty inches long, with a sharp toothed edge;—2. The smooth-edged reaping-hook, in form and shape like the former, only broader;—3. The badging or bagging-hook, which is much larger, heavier, and broader at the point, than the two preceding;—and 4. The sickle-hook, which has teeth only half its length, commencing from the point. These implements are all generally known. The preference is given to the sickle, on account of its frugality, as it does not cut the corn, till the reaper has gathered all the ears into his hand, while reaping-hooks sever many of them when introducing among the corn-stalks.

Observations.—The superiority of the sickle to the reaping-hook is very clearly, though unostentatiously pointed out; and the circumstance is well deserving the attention of the farmer.

On Wheel-carriages. By T. ESTCOURT, *Esq.—Communications to the Board of Agriculture, Vol. V.*

THE writer observes that the satisfactory result of Mr. Cumming's experiments on broad-wheel carriages, and the evident superiority of cylindrical to conical wheels, are equally curious and important, as relating to roads; but he often heard it observed, and coincides in the opinion, that no improvement in the form of the wheel can compensate for the injury arising from the immense weights they carry; he therefore deems it a subject more interesting to the agriculture of the country, and more connected with the improvement of the roads, to investigate the question, Whether the use of one-horse carts for all purposes to which they are applicable, would be an improvement upon the use of waggons and carts drawn by a number of horses? He then suggests the mode in which the queries should be drawn up, and remarks, that, if the result should be decidedly in favour of one-horse carts (of which he has no doubt), the general adoption of them might be brought about by a heavy parliamentary duty on waggons and other carts, from which these should be exempted. These remarks are mixed with some opinions respecting the propriety of

altering the mode of assessment for highway rates, and rendering all visible property subject to them; but we have no inclination to follow him in these speculations, and indeed it would be foreign to our purpose.

Observations.—Mr. Estcourt perfectly agrees with the two other writers, whom we have noticed in a former number, on the injury arising to the roads from the broad conical wheels now in use. The propriety of his suggestion of remedying the evil by the introduction of small carts, seems to us very questionable, as it would tend to increase the number of horses employed in agriculture, which, it is generally admitted, ought rather to be diminished.

On the Improvement of Path-ways bordering the Turnpike Roads. By AMICUS.—*Dickson's Agricultural Magazine, No.* 8.

THE improvement recommended is, to lay the scrapings of roads in a straight line under the banks and hedges, instead of suffering them to remain an irregular rude mass; by which means a causeway would be formed in the course of two or three seasons for the accommodation of foot passengers; and to keep this causeway always on the same side of the road. The neat causeway, reaching from Calne to Chippenham, in Wiltshire, is mentioned as an illustration of the good effect of this practice. It is also suggested that scrapers, formed in the segment of a circle, would clean roads more effectually than the straight ones usually adopted: a suggestion dictated by good sense, and deserving of notice.

ERRATA.

In *p.* 537, *l.* 17, of our last volume, for $\frac{b}{10}-1$, *read* $b^{\frac{1}{10}}-1$. This correction is indispensable to the employment of the theorem; but we understand that Dr. Young has lately presented a paper to the Royal Society which will supersede all these calculations.

After the word "*invention,*" at the end of *page* 47 of the present Number, the following words were omitted to be added to the observations on Messrs. Chapman's patent:—"*excepting as to the advantage of forming the belt of strands of shroud-laid rope instead of several small ropes.*"

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. XIV.] *April, May, June.* [1808.

AGRICULTURE.

History of the Merino-Ryeland Breed of Sheep, by Dr. PARRY.—*Communications to the Board of Agriculture, Vol. V. Part II.*

THE history of the author's own breed of sheep is introduced by an account of his first turning to agriculture, and particularly the care and improvement of sheep in the year 1788; but as he was not able to procure a Merino ram till 1797, it is only necessary to notice his detail from that time. From 1797 he has been enabled regularly to employ rams of the pure blood in his own flock, and had obtained in 1805 a total of 382 fine-woolled sheep and lambs, besides nearly 100 of mixed breeds. Dr. Parry seemed to have long reasoned upon the project of producing fine wool in England, which should be fully equal to the best Spanish, and to have entertained an almost certainty of success. For though general opinion had long decided that it was impracticable to raise in this country wool equal to that of Spain, yet it appeared to him that this opinion, whether as referable to climate, food, or habits of travelling, was founded on nothing better than mere prejudice. He had remarked that the skin and the hair of the Negro and Gipsey in England remained unchanged, from what they originally were in Africa, Hindostan, or Malacca; those of the North American, of West Indian and of European descent, continuing similar to those of their native

country; that the form and feathers of the turkey and domestic fowl, continue similar to those of their native country, whether in North America or Asia; and that the Arabian stallion delivered down his most boasted excellencies through our native mares. When he considered that these circumstances took place in spite of all the changes of climate, food, and general habits of life, he concluded from analogy, what has been since verified by experience, that Merino sheep would produce wool equally fine in this country as in Spain: his opinion was strengthened by the circumstance, that the Finlander and the Laplander, contiguous inhabitants of the northern parts of Sweden, continue to this day two distinct varieties of the human race.

When he turned his reflections from other animals to the race of sheep, it struck him forcibly that the Portland sheep, though one of the smallest races in Britain, and living on a bare natural pasture in a temperate climate, produced a small fleece of the coarsest clothing wool; and that the same circumstance took place in regard to the sheep on the cold mountains of Wales; and on the other hand that the Merino breed inhabiting Spain had the finest fleece in the world in all the different situations of that country; he felt a conviction therefore that the fineness and weight of fleece are by no means relative to the climate, soil, quantity or quality of food, size or habits of life of the sheep themselves. To these arguments from analogy, he adds the decisive test of direct experience in the Merino being naturalized in Sweden, Denmark, Prussia, Saxony, Silesia, Hungary, Austria, Hanover, Holland, Bayreuth, Anspach, Wirtemberg, Baden, France, Switzerland, Piedmont, the Cape of Good Hope, and New South Wales, as well as in this country: in almost all which countries the food and treatment of the sheep, as well as the climate, admit of so many variations. Yet under all this diversity of climate, soil, and treatment, the Merino sheep have flourished and produced wool equal to the native growth of Spain. He concludes these observations by asserting that "these facts surely prove that it is the peculiarity of the breed, which we are to consider, as chiefly productive of fine wool, in spite of the operation of other causes."

It has been stated in the first part of the Essay, on the authority of the continental writers on the subject, that any breed of ewes, however long and coarse in the fleece, would on the fourth cross of the Merino ram give progeny with short wool equal to the Spanish; but this opinion the author corrects from his own experience; for though he found this to take place in four crosses from the Ryeland breed, yet it did not obtain in four crosses from the Wiltshire, and the same held true with regard to the specimen of Cape wool of the same cross, which he obtained from Sir George Yonge; though in the two last cases one cross more would have effected it; he infers therefore that the exact

number of four crosses being sufficient to produce the finest wool must not be admitted as a universal proposition.

A table is then added, with observations as to the probable increase of a given number of sheep crossed by a Merino ram in certain predicated cases, but as these are rather speculative than practical, we shall pass them over.

The author of the Essay next observes that "we have no right *à priori* to conclude the Merino fleece to be, in any view, the best which can exist on a sheep," since it cannot be decided that in point of smallness, strength and inelasticity of filament, wool may not be produced superior to the Spanish; and he gives it as his own opinion that this is the case in the union of the Merino with the Ryeland. The superior softness and silkiness of the wool of the fourth cross of his Merino-Ryeland breed to that of the pure Negrette flock from which it is derived, is stated not to admit of doubt; and it is suggested that farther improvement may be obtained by carefully and continually breeding in and in from sheep at that degree of mixture; but he has found the wool of a whole generation made considerably coarser by a fifth cross of the pure Merino. He at the same time admits that his great choice of rams of the Merino-Ryeland mixture gave him an advantage of selecting from his own flock, rams with finer fleeces than Merinos. It is added that the wool of Lord Somerville and of His Majesty is finer than the original pile of the Negrette flock in Spain; and that the same is true of the Rambouillet flock in France, that of M. Pictet of Geneva, and that of the Elector of Saxony.

In order to demonstrate to the Board of Agriculture the further improvement which had arisen from a careful admixture of animals of the fourth cross, Dr. Parry submitted to their attention many specimens of his own, as well as of Spanish wool, and of cloth and casimir manufactured from the produce of his Merino-Ryeland race, for which he claims a decided superiority to cloth and casimir manufactured from pure Spanish wool: many particulars are detailed which would not well admit of abridgment, but it appears that the Refina, or finest sort of wool, bears a greater proportion to the whole fleece of Dr. Parry's than in the fleece of Spain; that the whole fleece is greater in weight, and the waste less in washing and scowering, even when the yolk is completely separated by the addition of an alkaline salt to the hot water, which is represented to be the only certain means of removing it entirely. The following Table is given as the result:— To obtain two pounds and a half wool, requires of unwashed wool, as follows:

	lb.	*oz.*
Of the author's Merino-Ryeland flock - - - - -	5	0
Of Lord Somerville's flock - - - - - - - - - - -	5	0
Of the flock of M. Pictet of Geneva - - - - - -	6	2
Of the Rambouillet flock - - - - - - - - - - -	7	8
Of the Merino breeds in Spain - - - - - - - - -	7	8
Of the mixed French breeds - - - - - - - - - -	6	2

Calculations of the value of the wool in the yolk are next subjoined; and the writer complains of the want of a market in this country for Merino-Ryeland in that state; and recommends reducing it by washing to the same state in which Spanish wool is imported, before it is offered to the manufacturer. To shew its value in the manufacture itself, comparatively with Spanish wool of commerce, he states that in 1804, 42lb. of Refina wool cleaned, scowered, and picked, made 26¾ of cloth, while 60lb. of good Spanish wool are required to make 30 yards, or according to one very intelligent manufacturer, 29 yards of the best wool dyed broad-cloth.

With respect to the price which Dr. Parry has actually made of his Merino-Ryeland wool, he declines naming it, because he has had much manufactured for himself and his friends, and has frequently sold only small quantities, not sufficiently large to regulate any market, or even to ascertain what clothiers would give for it, as he has not provoked competition; and besides he does not think it honourable to disclose any secrets of the woollen manufactory, which he may have obtained through the partiality of his friends in that department of trade. He says however that the manufacturer will be sufficiently apprized of the value of the wool, when he is told that the piece of blue broad-cloth already mentioned was sold for 24*s.* the yard, and at the same time a piece of casimir made of somewhat inferior wool at 7*s.* 3*d.* per yard, to the same draper, both ready money, and without deduction of length; and that he had been offered 30*s.* a yard for another piece which he exhibited to the Board.

The account thus given of the Merino-Ryeland wool is applied only to that of the ultimate degree of fineness, or at least of that degree which is equal to Spanish wool of commerce; but it is not to be referred to the wool of crossing in the intermediate degrees, as the author had either mislaid or forgotten most of the observations during the course of the experiment; but he had observed that the first mixture of the Merino with the Ryeland adds about one-third or somewhat less to the fleece of the latter breed, without having much influenced its fineness; that the second and third mixture of these breeds carries the wool of the ewe to the length of four, and sometimes six inches, with great increase of weight, but still considerable coarseness in the filament; and that the fourth cross brings the wool to the Spanish

standard in point of fineness, and greatly reduces the length, leaving it still somewhat greater than the pure. And the reader is referred for a more particular account to the publications of Lord Somerville and Mr. Tollet.

After these comments on the wool of the Merino-Ryeland sheep, he next considers that of the lamb; and states that the Merino lambs wool imported into England is much coarser and more wiry than the sheeps wool; it also appears to him that the fourth and fifth crosses of the Merino-Ryeland with the Negrette ram have also this tendency; while from 72 lb. of his own lambs-wool carefully selected, which was reduced by washing and scowering to 42 lb. a piece of blue ladies broad-cloth of the length of 28½ yards dyed in the wool, was manufactured by Mr. Naish of Tiverton, which the author sold for 21*s.* per yard ready money, and without deduction of length; and the draper who purchased this cloth publicly declared that having had one of these coats constantly in wear from six to nearly twelve months, he never had any which remained so long unaltered as to pile and beauty.

Having finished all that he deemed necessary to state as to the wool of the sheep, he next proceeds to the carcase, and relates that in point of size his Merino-Ryeland sheep are equal to the Ryeland; and after arguing upon the comparative profitableness of the larger or smaller breed of animals, in the opinions of both farmers and butchers, gives his own in favour of the smaller breeds of neat cattle and sheep, which was also the general result of the experiments made by the late Duke of Bedford, by Mr. Billingsley and Mr. Davis. He judiciously remarks that "a small sheep becomes fit for food from a proportionably smaller quantity of keep, than a large one, and the joints into which it is divided, are better accommodated to the use of common families," and thinks the minimum in point of convenience to be between 14 and 18 lb. per quarter, to which size wedders of the Merino-Ryeland breed are easily brought. With respect to the fitness of fat itself, he remarks that a certain proportion of it according to the modes of cookery in England, and he thinks he might add in England only, is coveted by every palate, and a larger proportion is desired by the labouring part of the people, who like it in their broths, their puddings and their fried vegetables, but that the number of such purchasers is very limited, and that among the middle and wealthier class of the people, and especially among their domestics, very fat mutton on the table is an object of aversion.

The author proceeds to draw a comparison between the smaller breeds of sheep, particularly the Merino-Ryeland, and the new Leicester, and decidedly gives the preference to the former. In forming his own flock he declares that his view has certainly been to place the finest wool on the best carcase, but as he thought the two objects incompatible at the same time during the com-

mencement of experiments in crossing the two breeds, he confined himself to the former object alone, which however is not yet fully accomplished.

It might be expected, he observes, that he should give some account of the fattening of the sheep, and the food and treatment best calculated for that purpose, but he could give the Board no satisfactory information on that subject, as he considers himself a mere breeding farmer, and had hitherto looked only to the extension of his flock and the improvement of his wool. He considers the Merino-Ryeland as a hardy race of sheep well calculated for living on high and exposed situations; more easily confined by fences, and more obedient to the shepherd and his dog, than the pure Ryeland; the skin also of the Merino-Ryeland has the same vivid tint of carnation as the pure Merino, and like that an astonishing degree of thinness, softness, and looseness.

Dr. Parry next treats of the health and diseases of Merino-Ryeland sheep, and asserts the breed to be fully equal to our native sheep in point of health; a few of his flock however have died of inflammation of the pleura, or membrane lining the chest and lungs, which manifested itself by the common appearances both before and after death; they are also subject to giddiness, principally in the first and second year, which frequently proves fatal, and invariably on dissection a bag of water is found in the cavities of the skull, occasioning a pressure on the brain. The most common disease, and at the same time the most difficult to cure, is the scab, which however is the same disease which affects other sheep, but the extreme fineness of the skin renders it more difficult to be eradicated than in the coarser breeds; and though the foot-rot is not enumerated among the diseases affecting Merino sheep either in France or Spain, yet Dr. Parry's mixed race have frequently suffered from it: upon the whole the Merino-Ryeland breed of sheep do not appear to be quite so hardy as some others, yet under that attention which it well repays, it is found to be full as exempt from disease, as any of our indigenous breeds.

And though the account, given of the different qualities of this breed of sheep, may seem sufficiently flattering to lead to a ready and wide extension, yet many difficulties and objections occur. The writer observes with regret that the chief obstacle arises from the backwardness of the manufacturer to give the proper price for the wool, which is felt not only by the common growers of such wool, but in the Royal flock itself; though it is acknowledged that the wool of this flock is better than that of the Negrette pile of Spain, yet in 1802 the Refina, clean scowered, sold only for 5*s.* 9*d.* per pound, while the manufacturer gave 7*s.* 3*d.* per pound for Negrette in the same state. Many pretexts are enumerated which have been offered by the manufacturers of, and dealers in wool, but they are all refuted, and resolved into wilful prejudice. Manufacturers, anxious to preserve the excellence and

established reputation of their approved fabrics, are not blame for doubt and caution in the admission of a new material; but it is asserted that when the value of this material becomes known, and it obtains its price, sufficient will be grown to supply the market, inasmuch as the extension of fine wool only languishes for want of encouragement. Several remedies are suggested;—to reduce it to the state of Spanish wool of commerce, before it is offered for sale;—for gentlemen of rank and fortune to give a preference to cloths made of wool of our own growth, that inquiries for such cloths might stimulate the draper to demand them of the manufacturer;—the establishment of central markets for fine British wool;—and the employing one manufacturer, selected by the growers, to make up for the market all the British fine wool which should be sent to him, at a certain rate, and with an accurate return of particulars. The chief difficulty which stands in the way of the farmer being thus removed, the demand for the wool would doubtless increase the breed to a vast extent.

The profit of this breed to the farmer, comparatively with others of the short-woolled kind, are then considered; and upon the supposition that there are three millions and a half of acres of land incapable of any improvement by the plough, and which at present make no return but by the wool of the sheep which they support, reckoning one sheep as the stock of two acres and a half, if Merino-Ryeland sheep were stocked on such land, and each sheep produced four pounds of wool in the yolk, a produce may be obtained of at least 6*s.* per acre every year by the growth of wool only. The best and fairest method of estimating the comparative profit on different kinds of sheep, is stated to be, not according to the number of animals, which would probably vary materially in weight, but according to a given weight of each race; and assuming 125 lb. the most usual weight of a South-down, as the standard, the following is stated as the produce of different breeds, viz.

	lb.	*oz.*	*dr.*
South-down, clean scowered - - -	2	6	$3\frac{1}{5}$
Ryeland in the same state - - - -	2	5	$2\frac{3}{5}$
Merino-Ryeland, in the same state - -	3	12	0

From which it appears that on 125 lb. of living carcase, the Merino-Ryeland carries 1 lb. 5 oz. $4\frac{2}{5}$ dr. of scowered wool more than the South-down, and 1 lb. 6 oz. $5\frac{2}{5}$ dr. more than the Ryeland. If therefore the three millions and a half of acres above mentioned of unimprovable land are supposed to carry not more than one sheep to two acres and an half, the produce of Merino-Ryeland wool, at 4 lb. per fleece in the yolk, would give 2,800,000 lbs. of clean wool, which at 7*s.* 6*d.* per pound would amount to £1,050,000; while the best price for the common wool now produced on such land does not exceed 2*s.* 2*d.* per

pound, and the greatest quantity does not exceed 1 ¼lb. of clean scowered wool from each fleece, giving the value of £139,583; leaving an annual superiority in favour of the Merino-Ryeland wool of £860,417, which is nearly five times the value of the present produce. Many calculations are subjoined to point out the number of Merino-Ryeland sheep necessary to produce annually an equal quantity of fine wool to that which is now imported from the Spanish market, all of which are obviously deduced from the foregoing premises.

Having remarked in the preceding part of the Essay, that the French found no material loss of weight in wool of the Merino breed suffered to remain two and even three years on the same animal; Dr. Parry relates that he has had a similar result as to the wool of a Merino-Ryeland; and though such wool might be inferior in value to the manufacturer of cloth, yet it would not become much deteriorated; for M. Pictet of Geneva and his wife applied these materials, by themselves, to the manufacture of shawls, which according to his description, as well as that of Mr. Poole, who had seen them, were superior in softness, lightness, and beauty to any produced in Norwich or other parts of England; and when he inquired of a friend as to the practicability of employing fine long wool for that purpose, he learned that he had been anticipated by Mr. Tollet, whose wool was actually in preparation for such an experiment. He states his own fleece before mentioned, which is six inches in length, and of the finest filament, to be ready for trial by any manufacturer of shawls who shall apply for it. He here concludes his remarks on the comparative value of the Merino-Ryeland breed of sheep to the farmer, the clothier, and the kingdom at large, having pointed out the most powerful motives for the extension of this and similar breeds: and next adverts to their management.

The first object of inquiry which presented itself, relative to the management of this race of sheep, was the proper age and season of propagation. It is related that the curators of the Merino flock of Rambouillet lay it down as a principle, that in order to ensure the true growth of the progeny, and an exuberant crop of wool, no sheep should be permitted to generate, till it be two years and a half old, by which time they consider the growth of the animal nearly completed: this principle they apply to the rams as well as the ewes, and its propriety seems to be evinced by the improvement of that flock, which in size of carcase and weight of fleece exceeds every other of the same race: while M. Pictet and some others on the contrary contend that it occasions great loss of time in obtaining a flock, and is contrary to the instincts of nature, which are infallible. Some truth is admitted to exist in the first proposition, but none in the second; and this is supported by reasoning from the analogy of what happens to other animals, and in the human race. On this point

however, various sentiments obtain; nor is there less difference of opinion as to the season and manner of putting the ram to the ewes; and it is asserted that in England these points are chiefly regulated by two considerations;—food, and the convenient falling of the lambs. The smaller breeds of sheep, which are usually fed on hills and dry lands, on which the spring of grass is late, are so managed that the ewes shall lamb from the middle of March to the middle of April, while the proprietors of several of the larger breeds are interested in early yeaning, either for house or grass lambs. It seems to the author as if there were in different breeds a natural variation in the period in which the female seeks the embraces of the male; for he remarked that 47 Merino-Ryeland ewes discovered these propensities much sooner than 60 ewes of the same age, which were either pure Ryelands, or a cross of the Leicester. This subject is dilated upon pretty much at large, and the various practices described; but as the Essay itself will be referred to by the curious sheep-breeder, who means to regulate his flocks by the suggestions it affords, it is unnecessary to particularize this part of it for any other class of readers. Dr. Parry gives it as his opinion that most advantages will result from permitting the sexual intercourse to take place early in the autumn.

The Herefordshire custom of housing, or as they call it, cotting, their breeding ewes and lambs, is descanted upon as a practice from which many benefits have been erroneously supposed to arise; and it is recommended as a better plan to elevate the various ricks in a farm-yard on a basis or floor five feet from the ground, under which the sheep might be either constantly or occasionally sheltered, and the ground be littered and kept clean like a house: a copious supply of proper food to the ewes and lambs is also mentioned, as an essential point to ensure success; and the shepherd is advised to give good hay, and to offer it in cribs rather than in racks, to prevent waste. Hay of quick growth is stated to be preferable to all other for sheep, because they uniformly reject that which is benty, and only eat that which is made from young and succulent grass; but the best sort of dry food is asserted to be linseed, which the author gave his sheep in the following manner;—one part of the whole seed was mixed in a tub with seven parts by measure of cold water, and suffered to stand all night; in the morning the whole was boiled up together; when cold it formed a jelly thicker than the white of an egg, and was given in troughs either by itself, or mixed to a nearly dry state with hay cut into chaff. In either way the sheep ate it readily, and the lambs themselves at a certain age; and both from habit became excessively fond of it: he never fed his own sheep with chopped straw, pease-haulm, or various other dried vegetables recommended by foreign agriculturists.

Considering it of great consequence to economize meadow hay, as much as possible, being the most expensive of all dry food, the author speaks of the lattermath of such grass as excellent food for sheep, as well as clover, lucerne, and sainfoin, on account of their succulence and tenderness; but what he recommends as the most profitable of all food, and which is always within our reach, is the rouen, or aftergrass, reserved through the winter; which, though many inches in height, is capable of being kept without loss in dry situations, and will be eaten up clean by sheep and lambs of all descriptions at the latter end of winter and in the spring: many years experience has confirmed him in his opinion of its excellence, and he pronounces the public under the greatest obligations to Mr. Arthur Young and other agriculturists, who have made known its merits. Of turnips he professes to know little by experience, but has found them on every trial much inferior to the cabbage tribe, on which he has long been accustomed to place his chief dependence for the winter and spring food of his flock, without ever having experienced disappointment. The general principle that vegetables should always be transplanted into a good soil from one that is poorer, he decidedly reprobates, and has always followed exactly the reverse; for he would treat seed like a fœtus in the womb of its mother, and a young plant like a young animal, and by a proper choice of seed, early sowing, warmth, defence against injury, and plenty of the most nourishing food, would push it rapidly, safely and uniformly through all its stages, so as in the time limited by nature for its growth, to give it the greatest possible dimensions and succulence. The writer's mode of sowing and raising cabbages is minutely described in the succeeding pages; but as it scarcely deviates from the practice of every good gardener, it need not be recounted. He has tried rape as a spring food for his sheep, and has found it profitable, and has occasionally given carrots and potatoes; but has discarded the use of all these as inferior to the cabbage; he also formerly provided chicory, or wild endive, as a change of spring food, but has now given it up in favour of spring vetches. Salt he never gave his flock but once, and then he mixed it among his hay, when it was made into the rick.

Adverting to the diseases of the Merino-Ryeland breed of sheep, he enumerates the hydatids in the lungs, giddiness, foot-rot, scab, scouring, hypobosca ovina or sheep-tick, the fly or maggots, tetanus or locked jaw. His observations on these diseases, which are all common to the several breeds of sheep in this country, contain little but what may be found in other writers, and nothing meriting particular notice. Few of the remedies recommended are peculiar to the work; it is however worthy of recollection, that for common scouring in sheep or lambs, when it is the result of mere indigestion, he found the following an

effectual remedy;—he took equal weights of salt and whiting reduced to a fine powder, and dissolved the salt in four times as many pints of water as there were pounds of salt, stirring in the whiting by small quantities; when this had been simmered over the fire till it became thick enough to make into pellets, he gave five pellets of the size of the tip of his middle finger to each of his ram-hogs every morning; and found the remedy effectual. He observes that the troublesome animal the sheep-tick may be in a great measure destroyed by pouring a solution of powdered white arsenic in boiling water, in the proportion of an ounce to a gallon, cold on the back of the sheep, and letting it diffuse itself down the skin on each side: he indicates the necessity of attending to the poisonous nature of the liquid.

As the value of the fleece renders the management of it an object of much importance, he recommends that the pastures where Merino-Ryeland sheep feed, should be carefully freed from thistles, briers, loose thorns, the burdock, clivers, and all other weeds, which either tear off the wool, or drop among it their rough seeds, which cannot afterwards be separated without much loss, labour, and expense; that the hay should be given in cribs, the fly be attentively guarded against, and the ordure which adheres to the tail constantly cut off. He agrees with the Spaniards in objecting to washing the wool on the sheep's back before shearing; for the fleece is so thick, that, when thoroughly soaked with water, it is so long in drying, that if the weather prove wet and cold, the sheep is much incommoded. His own time of shearing has usually been about the second week in June, but the period ought to be regulated by climate, season, and other circumstances, and the operation should be performed earlier on the Merino, than on our native breeds, and if very cold or wet weather follows, the sheep should be housed for two or three nights: the wool should be clipped round the animal and entirely separated at one cut, which cannot be done in the common method of shearing lengthways. The wool should be kept in baskets, rather than in bags, and be shorn dry, and laid up in a two-pair of stairs room on a boarded floor. The perfection of the washing is said to depend a good deal on the season, and ought to be done, if possible, before the end of October, after which period the water would cool too soon, and the shortness and coldness of the days would make it difficult to dry the wool: the water should be heated to 144 degrees of Fahrenheit's thermometer, and the wool be steeped at least eight or ten hours; and after the washing be rinced in a running stream if possible; and should then be drained or pressed; but the latter method is preferred. The wool is then in the Spanish state, after which the yolk must be farther detached by scowering before it be manufactured. The lambs are usually shorn unwashed at the end of July or beginning

of August, and have not appeared to suffer any injury. The author proceeds to remark that it may be easily inferred from what has been said with regard to the relative quality of the lamb's wool, that no decisive judgment can be formed from it as to the future fineness of the fleece; and he is persuaded that a still worse decision can at that period be made as to the size and proportion of the carcase; so that the value or excellence of a ram cannot be ascertained till he is three or four years old: this circumstance renders him extremely averse to the castration of the lambs, which he never performs except on those who have either sprung from coarse-woolled ewes, or are grossly defective in point of carcase. He has hitherto weaned his lambs at once, without any apparent disadvantage either to the dam or the young; but it has been necessary to milk the ewes twice or thrice afterwards at the interval of two or three days. He observes the horns of the rams may be shortened to about six inches without any inconvenience by a saw, and if the entire banishment of the horn be desired, he knows it may be effected by breeding from polled rams: and he considers the best mode of marking the rams to be branding them on the horn with a hot iron.

The last chapter of the Essay is on the mode of forming a flock which shall have superfine wool on a beautiful carcase, so as to combine the essential points of wool and carcase in the greatest degree. The author does not see however by what means, in the beginning of an experiment, we can proceed with equal pace towards both these objects. "If," says he, "our view be goodness of form, we need not go for that purpose to Spain, but may better accomplish it in a single day in Sussex, or in Leicestershire: but the new and great point is to superinduce the Merino fleece." He considers it extremely probable that the female has more influence in the production of form than the male, and is confirmed in this sentiment because the lambs got by the finest-woolled ram, which was not well-shaped, and smaller than most of the other males, turned out to be larger and better formed than the generality of his other stock; and he has noticed the same thing to happen in other animals. He also apprehends that a ram of the cross breed is as good for the purposes of propagation as an equally good Merino ram, and better than one that is inferior. With respect to what the ignorant call "Nature," and those who fancy themselves more learned, "Blood," he considers it to be nothing more than an abstract term, expressive of certain external and visible forms, which from experience we infer to be inseparably connected with those excellencies we most covet; and gives it as his opinion resulting from all his observations and experience, "that he who at this time beginning to breed, prefers the best pure Merino ram to the best Merino-Ryeland, will probably find himself eight years behind in the experiment." And after a flock of Merino-Ryeland sheep has

been obtained, nothing seems to him to promise greater benefit in the improvement of it, than a division into classes according to age and strength; as the robust always harass the weaker and drive them from their food.

The Essay is concluded with a notice that M. Pictet is now trying at Geneva, as Columella formerly did at Rome, some experiments to introduce a coloured wool of natural growth, but much success is not expected from it. And having faithfully related every thing important which he knows either from his own experience, or good authority, relative to the pure Merino, and Merino-Ryeland breeds of sheep, he states that the disposition in the Merino-Ryeland breed to assume the *paternal* fleece and the *maternal* shape, has led him to conclude that this principle might be advantageously applied to the union of the finest-woolled ram with coarser ewes pre-eminent as to form; and with this view is now trying experiments with ewes of the Leicester-Ryeland, and Leicester-South-down crosses, though at his advanced period of life he dare not flatter himself that he shall live to see the result.

SUPPLEMENT.

The Supplement, besides stating a few additional facts which confirm the opinions offered in the body of the Essay, gives an account of a method of measuring the relative fineness of the filaments of wool, a table of comparative diameters of the filaments of various clothing wools, and the results of these admeasurements. The uncertainty of all the modes which have been previously adopted induced the author to apply to Dr. Herschel, who advised him to make use of the method which he has described in an account of his lamp-micrometer in the Philosophical Transactions for 1782. He availed himself of these suggestions, and soon found that the relative diameters of minute objects might be ascertained with great precision by placing an object of a known diameter on the stage of a microscope in a strong light, and a piece of white paper spread horizontally beneath it; then by looking through the tube at the object with both eyes open, its image may be seen projected on the paper below, which may be measured with a pair of compasses; and if the magnified object be divided by the known diameter of the object, the magnifying power will be ascertained. This being found, place on the stage the object of which the diameter is sought, and having measured with the compasses, as before, the diameter of its image projected on the paper below, divide that diameter by the magnifying power, and the quotient will be the real magnitude required. He applied this principle to the filaments of various clothing wools strongly illuminated by the reflected light of an Argand lamp, and has given a table of their diameters at the outer end of the filament, the middle, and the inner end, as well as their mean diameter.

It resulted from the admeasurements made by Dr. Parry;—1. That the wool of one of his ewes was considerably finer than that of any other kind, which he had an opportunity of examining; and the wool of another nearly as fine as the best Spanish pile.—2. That the wool of two of his rams, both of which sprung from Merino-Ryeland sires with ewes of the same cross, was finer than that of any ram of any breed, which it had been in his power to measure, and that one of them was superior to any imported wool of either sex.—3. That the wool of all his rams similarly descended, which he had measured, was finer than that of 3 out of 5 of the pure Merinos.—4. That the Negrette breed of sheep is greatly improved in its wool by having been introduced into England; the specimen of the Royal flock which he measured being finer not only than the finest of that pile procured from Spain, but than any other Spanish pile which he had seen.—5. That the Merino wool may be considerably improved in fineness by an admixture of the Ryeland breed, and afterwards by breeding in and in from the fourth cross of that breed.—6. That in a coarse-woolled breed of sheep, as that of the Cape of Good Hope, four crosses of the pure Merino are by no means capable of bringing the wool of the produce to an equality in fineness with the paternal race.—And, 7. That so far as these observations go, the form of the filaments of clothing wool is not that of two cones joined together by their apices, but that of a single cone, of which the apex is next the skin.

Observations.—This Essay, together with that by the same author noticed in the last Retrospect, p. 98, may be considered as a complete history of the Merino breed of sheep, as well as of all attempts to introduce them into the different countries of Europe. In this point of view the information is certainly important, but it is much more so as detailing the means by which the introduction of fine-woolled sheep into our own country may be attempted with scarcely a doubt of success, and as pointing out that even a superior degree of fineness of wool, than has yet been known in Spain, may be obtained by a judicious admixture of the Merino with the Ryeland breed. The account of the author's own flock is much less deserving of notice as a private memoir of successful husbandry, than as an elucidation of the principles on which superiority of fineness may be obtained in wool at the same time with an accession of weight and symmetry in the carcase of the animal.

An attentive perusal of the account here given of this Essay will render superfluous any observations recommending it to the perusal of the readers of the Retrospect. The accuracy with which Dr. Parry's experiments have been made, and the clearness with which they have been detailed, do of themselves sufficiently stamp the value of the Essay. In the compass of a

single half volume every thing is comprized which has been known or published in the various countries of Europe respecting the Merino breed of sheep, together with a most minute and particular account of the effect of mixing that breed with one of the most valuable of our native races of sheep.

To point out any particular parts of the Essay as more worthy of approbation than the rest would be doing justice neither to the author nor to the reader; though it may be affirmed that the second part is more important in point of information than the first; as it contains the history of the writer's own flock of the mixed breed, while the first part is only a collection of all that is valuable in other publications.

We must however protest against the reiterated attempts of Dr. Parry to excite attention, by republishing in different forms the history of the Spanish flocks, a subject which certainly does not require being pressed upon us so frequently as it has been. We recollect seeing the greater part of this Essay in a quarto pamphlet published by the Doctor in 1800.

On Gypsum.—Annals of Agric. No. 267.

This anonymous article states that Mr. Smith of Eastling, near Feversham, Kent, found "that on stiff loams full of rough flints, eight feet deep, on chalk, gypsum will seldom have any effect; but that if such land be chalked, then the gypsum takes effect as well or better than on any other soil."

Observations.—This article has not been selected from the last published number of Mr. Young's Annals for any peculiarly valuable information which it conveys, but because it is the *only* article which comes within our province; the remainder of the publication being filled with the proceedings of the Smithfield club, and Lord Somerville's cattle show, a letter on the expenses of arable land, a paper on fallowing, wholly copied from Mr. Nasmith's Elements of Agriculture, and tables of the import and prices of grain.

On the Construction of Carts and Waggons used in Husbandry, with Remarks on their Effect on Roads. By Thos. Howard, *of Henlaugh, near Tadcaster.—Dickson's Agric. Mag. No. 9.*

This writer considers that there is great want of improvement in the construction of these implements; he allows the superiority of iron axle-trees over wooden ones on hard roads, but much doubts whether they would answer on any farms but such as are exceedingly dry: he thinks four feet a sufficient height for the fore-wheels of a waggon, and four feet six or eight inches for the

hind-wheels, where the roads are hard and smooth. It has occurred to him that it would a great improvement if the axle-tree of the fore-wheels were made of such a length as that the inner edge of the fore-wheels might run exactly in a line with the outer-edge of the hind wheels. By this alteration, he says, the waggon would turn more easily, and the fore-wheels be prevented from rubbing its sides, and the great objection to the use of waggons as prejudicial to roads, namely, that of cutting the road into ruts by two wheels running exactly in the same line, would be removed. The preferable breadth of a wheel, in his opinion, is six inches.

Observations.—There is no novel suggestion or remark in this communication, except making the fore axle-tree of a waggon longer than the hinder one, to prevent the wheels following each other in the same track; but if this were adopted the difficulty of draft will be considerably increased, for a double number of obstacles must be overcome; because in the common method making both the axle-trees of the same length, the fore-wheels remove opposing obstacles, and the hind-wheels follow smoothly where the others have levelled the way; but in the mode recommended, whatever is pressed in by the fore-wheels will be to be forced out again by the hinder ones; and this must necessarily happen on all roads not perfectly hard and solid.

A simple and easy Contrivance for discharging the superfluous Quantity of Water from Ponds, Tanks, and Reservoirs, in Times of Floods, &c.—Dickson's Agric. Mag. No. 9.

The contrivance described in this paper is said to be the invention of the Rev. Mr. Leg of Ashprington, Devon: it consists in a beam of wood suspended by an iron pin (over the head of the water) so as to form a kind of lever or balance, having one end affixed to a chain which raises a plug to let out the superfluous water, and having suspended at the other a box or bucket, made rather leaky, into which the water is conveyed by a pipe whenever it rises to a certain level. As long as the bucket continues filled with water, the weight will raise the plug, and when the water no longer keeps the bucket full, the plug will return to its place, by the lever recovering its level position.

Observations.—This invention may answer very well in a garden or inclosed paddock, where the machinery cannot be got at by indifferent persons, for it is extremely liable to be out of order, and consequently can never be applied in exposed situations. There is more ingenuity than usefulness in the contrivance.

A convenient and useful Implement for thistling Grain or other Crops.—Dickson's Agric. Mag. No. 9.

This tool is formed in the manner, and on the principle of forceps, and consists merely of two blades or arms of about three feet in length, well fitted to each other, and moving on a strong pivot or pin near the bottom part or mouth. Each blade is crooked inwards from the neck or place where the pin passes through, so as to fit in an exact manner with five or six blunt teeth.

In using it, the weeder walks along the ridges, and applies it to thistles, docks, and other weeds close to the surface of the ground, so that they are forced with all, or a considerable length of the root; by which means a great extent of ground may be cleared in a day. When the tool is made of iron, the blades are made with sockets, into which handles are fixed.

Observations.—This implement, which is exactly like a pair of garden shears, except that the blades hold firmly the weed instead of cutting it, may be used with much advantage in weeding corn at such times as damage would be done by going among it to pull up all the weeds by the hand, and there is little doubt but that practice would render it as manageable as the weeding-hook; it might also be used with much effect in drawing thistles upon grass lands, as preferable to spudding them.

Remarks on the Advantage of different Heights of Wheels in moving on inclined Planes, and on the Size and Construction of Axle-trees. —Dickson's Agric. Mag. No. 9.

These remarks are in continuation of some which appeared in a former Magazine, and were noticed in the last Retrospect (see p. 88). It is given as a common opinion that in moving a carriage up an inclined plane, the draught is greater with a high wheel than with a low one, but this is shewn to have no foundation in mechanical principles; and by a train of mathematical deductions, which it is unnecessary to follow, it is proved that in moving a wheel up an inclined plane the draught is somewhat less with a wheel of less diameter. Some remarks on the diameter of the axle are added, being, in the opinion of the writer, a subject of importance. He supposes one axle double the diameter of another, but the wheels of each of an equal height; and as in moving up an inclined plane the axles are drawn or slide forward, so that the point of contact of the axle with the hole in the wheel is above an horizontal line touching the bottom of the hole; and

as such a point of contact in a large axle will be twice the distance from a perpendicular line, passing through the centre of the hole, than the lesser axle is, the angle of draught is rendered less with the larger axle, and consequently the draught itself less also.

It is likewise noticed that the course or track of the wheel with a larger axle, is not so *serpentine*, as with a less axle; and also that the greater the diameter of the wheel, the greater will be its serpentine course, which increases the draught in a trifling degree. From which it is inferred, that in the construction of wheels, they should be made as low and the axles as large, as is compatible with other considerations of equal consequence.

The writer observes that an iron axle may be increased in diameter, without being increased in weight, by making it a tube, instead of being a solid cylinder; which, on every mechanical principle, cannot diminish its strength; and he considers the difference of friction between an axle of six, and one of three inches diameter, even when the weight to be supported is great, to be extremely inconsiderable; and he points out that this may be much diminished by shortening the boxes, or by forming them with circular grooves, which he also conceives would be advantageous in another view, inasmuch as this formation would tend to retain a greater portion of grease, and for a longer time.

Observations.—Many of these remarks discover an acute mind, and are well deserving the attention of those who apply themselves to a consideration of the same subject. It is easy to perceive that they are the result of theoretical opinion rather than of practical observation, but they suggest many hints too valuable to be neglected.

Essay on the Nature of Vegetation, and the Means of preventing the Deterioration or Exhaustion of the Soil by the Crops which are grown upon it.—Dickson's Agric. Mag. No. 9.

The object which this writer has in view, is justly considered by him of great importance, for it is no other than to point out the real cause and assign a remedy for that deterioration and impoverishment of soils, which never fails in a greater or less degree to follow the growth of certain plants. But as some crops have not the same injurious effects upon all soils, he does not think it necessary to have recourse to the same precaution in every case, and therefore confines his observations to the cultivation of what are called impoverishing crops, such as wheat, oats, barley, &c. and in order that the propriety of the practice he is about to recommend may be the more easily investigated, he commences with some account of the theory, on which it is established.

This theory is raised on the hypothesis that air, and water, and light, and substances which they hold in solution, furnish all the elements of vegetable existence; an opinion very commonly received about a century ago, and which seems to have been suggested by experiments and observations upon vegetation; one of which, by Van Helmont, is particularly noticed by this writer in confirmation of his opinion. "Van Helmont planted a willow in a pot, containing earth which had been previously weighed; he supplied it regularly with water, and found that after some time it had acquired a great accession of weight, with little or no diminution of the weight of earth; wherefore he infers that it is fair to conclude that, from whatever sources plants may derive their food, the soil in which they grow is far from contributing any part of it. Nor does he conceive that this theory is without some support from the discoveries of modern chemistry, for vegetables analyzed by chemists are found to contain only light, the elementary substances which compose air and water, and such substances as these fluids hold at all times in a state of solution. And though vegetables are frequently found to contain earth, particularly lime, he removes the objection arising from this circumstance by the known fact that lime is held in solution by most water, being in this way easily received into the vessels of plants through the pores of their roots, and may thus become an accidental without making a necessary part of the vegetable substance. On this principle also he explains why some plants do not grow as well on certain soils as on others of nearly the same dryness, since the water which pervades them may hold in solution earths, salts, or other substances more or less deleterious to vegetation. Aware it may be objected to him that one of the principal ingredients in the composition of most vegetables is what chemists term carbon, he remarks that the carbonic acid gas is contained not only in most water, but also in the atmosphere, so that it may be conveyed into vegetables by being held in solution in water, or, being heavier than common air, and consequently subsiding to the ground, may be absorbed by them in this way; so that earth appears by no means a necessary medium of conveying carbon to plants; and indeed some species of vegetables obtain their support almost without the aid of roots, and grow upon the rocks without any vegetable mould whatever; and yet these, as well as other plants, give carbon when submitted to an analysis. If in these cases the substance in question be not the natural result of vegetation uncombined with external causes, it must be obtained from air, or water, or light. Besides, exposure to the action of light is held to be necessary to this substance, since the roots of plants, and such vegetables as are made to grow in the dark, rarely produce it. It appears to him then, that, when plants are exposed to the influence of light, the water contained in them is decomposed, and thus the carbonic substance united with the plants.

Taking notice of the acknowledged truth, that while some crops, if they do not absolutely improve, have no tendency to exhaust or impoverish the ground, yet others are universally admitted to be injurious in that respect, he observes that this seems impossible on the supposition that vegetables derive their principal support from the soil; for if they did, the quantity of matter taken off the ground by any crop ought to measure pretty nearly the quantum of its deterioration, instead of the leaves, roots, &c. left behind, measuring the quantum of its improvement; but the hypothesis, which supposes plants to derive their support entirely from air, water, and light, easily explains, in his opinion, why the soil is not impoverished after certain crops; and that this theory is liable to much fewer difficulties than that which supposed earth to be the food of plants.

It is also contended that the hypothesis maintained in this article fully explains why rich soils are more favourable to the growth of plants than poor ones; and it is accounted for in this way:— "Dr. Priestley found, by experiment, that vegetables throve best when they were made to grow in air made putrid by the decomposition of animal and vegetable bodies, and that they purified such air in all probability by attracting and fixing the heterogeneous gases with which it was mixed: he found too that vegetables flourished exceedingly in air which had been rendered impure and unable to support animal life by having been frequently respired by animals: the Doctor also found that when plants were made to grow in this air, they soon restored it, and rendered it capable of supporting animal life again." From which premises it is inferred that putridity, or those effluvia which result from the decomposition of animal and vegetable bodies, and from respiration, are the proper food of plants; and it is asserted that vegetable mould also, as well as vegetables, has the property of attracting and fixing putrid effluvia, for that which arises from the decomposition of animal bodies buried but a small depth under-ground never penetrates through, so as to become offensive; whence it may reasonably be concluded that it is attracted by the soil. Taking it for granted then that there exists at all times in the atmosphere a certain degree of putridity, and that putridity is the food of plants; and it being admitted that vegetable mould as well as vegetables attract the putrid effluvia, he conceives it will be easy to shew why vegetables thrive better in a rich soil than in a poor one, without having recourse to the supposition that the soil itself furnishes any important part of their sustenance. For a rich soil, approaching nearer to being saturated with putridity than a poor one, exerts less powers of attraction to absorb the putridity of the atmosphere, and consequently counteracts in a less degree the attractive power of the plants which grow there; in short, on the supposition that vegetable may be saturated with animal and vegetable matter, and that it is disposed to attract putrid effluvia in

proportion to its poverty, it is manifest that the poorer the soil is, the poorer will be the crop, since the soil itself has absorbed that which would otherwise have been the nourishment of the vegetables.

Having thus explained why a rich soil is more favourable to the growth of plants than a poor one, he proceeds to shew why the ground is invariably impoverished after the production of certain crops. It is generally understood, he says, that wheat, oats, and barley are impoverishing crops, to which rape and flax may perhaps be added. Of these plants he observes that they are ripe and cleared off the ground early in the year, leaving the ground bare and exposed to the sun at a season, when the heat is greater in the daytime than at any other period; these crops too usually stand thin upon the ground, and on that account leave the surface considerably exposed during the time of their growth. On the contrary, "the improving crops, as they are called, such as beans, and especially when they are mixed with lentils, turnips, clover, carrots, &c. are not ripe or removed from the ground till late in the year, when the violent heats of summer are over; and though clover is sometimes cut down early, yet it shoots again immediately, so as to afford a shelter against the scorching heat of the sun. If therefore it should appear on investigation that all crops impoverish the ground in proporton as they leave it exposed to the action of heat, either during their growth, or by being ripe and cut down early, and that all crops have an improving effect in the same proportion as they are of a contrary description, it seems to him to follow necessarily that the important problem is solved, and the real cause of the deterioration of soils discovered;—and that it only remains to point out an adequate remedy for the mischief.

It is remarked, in confirmation of the truth and accuracy of this opinion, that in a crop of clover the plant will miss here and there, from a cast having been omitted in the sowing, or from the seed having been destroyed by the birds, and wherever this is the case the spot which has been left bare of clover, and exposed to the sun's heat, is invariably impoverished, and the effect is so striking that it is easy to distinguish the particular spot for some years. In like manner, wherever a crop of clover or any other covering vegetable has been most abundant, the succeeding crops have been the best in the very same places. In the cases alluded to, the ground is found to be exhausted not by an abundant, but by a scanty production of vegetables, and the degree of deterioration to be in proportion not to the abundanee, but the deficiency of produce.

In order to shew that these sentiments are not peculiar to himself, the writer refers to the Encyclopædia Britannica, the Encyclopædia Perthensis, Lord Dundonald, Mr. Parkinson on the Agriculture of America, and other authors, considering that the

evidence which they afford, that soils are liable to be deteriorated by exposure to the action of heat, is so strong and satisfactory, as to leave no doubt that this is *one*, if not the *only* cause of that deterioration.

On the same principles he accounts for the cause why mowing clover a second time does not tend to impoverish the soil, for it immediately shoots again and covers the surface with the shelter of its leaves; and he relates a circumstance which occurred to himself, where in a crop of barley after clover, the only part which was deficient, was a single land where the clover crop had failed, and here was not only much in quantity of plant, but the produce was also less in proportion to the quantity of straw, than in the other parts of the field.

Assuming it then to have been proved that exposure to heat is the principal cause of the deterioration of the soil, the writer recommends to sow clover, grass, or any biennial plant, at spring in all the early crops, in order that when the crops are ripe, the clover, grass, &c. though but short, may form a shelter capable of protecting the soil in some degree from the action of heat; and he advises this to be done with *all* early crops, even when the ground is intended for a corn crop the following year, for in that case the clover may be eaten off by cattle previous to the ploughing, or may be ploughed in, and will be found an excellent manure. He considers the herbage will amply compensate for the expenses of sowing, besides preventing that greatest of all agricultural evils—the impoverishing of the soil.

Many observations are subjoined in elucidation and confirmation of these opinions, but as they are merely of a speculative nature, it is unnecessary particularly to notice them; and the Essay is concluded with a remark that the introduction of *sheltering* plants cannot fail to produce important advantages to agriculture, since by means of them the ground may be kept clear from weeds, and at the same time be progressively improving in richness; fallows may become unnecessary, and a vast augmentation of animal food be produced from this source with a great diminution of human labour.

Observations.—Without expecting all the benefits to result from the adoption of the practice recommended in this article, which have teemed in the mind of the writer, we must do him the justice to allow that his theory is well supported, fairly deduced, and has been assented to by many old writers on vegetation; but it cannot lay claim to novelty. In his deductions he has been too inattentive to the rules of logic, and a reader of the article must not be surprised if he does not arrive at all the conclusions on the first perusal, as the writer himself seems to have been bewildered more than once in his ratiocination. The conclusions however will be found to be accurately as we have given

them, and deduced from the same premises, though in a much more circumlocutory manner. The theory, that plants draw their nourishment from air, water, and light, and substances held in solution by them, appears to be liable to fewer objections than any other, but we do not see how *exclusively* it leads to the conclusion that the action of heat deteriorates the soil, for the same effect would arise from the action of heat on the hypothesis that earth was the food of plants. The soil is exhausted by a crop, either because the crop takes something from it, or because the crop prevents it from acquiring something which it would otherwise acquire; and covering the surface from the action of heat may perhaps counteract the one and prevent the other. This writer seems to have forgotten that fallows are had recourse to, not *solely* to ameliorate the ground, but *also* for the destruction of such weeds as can only be destroyed by ploughing at those seasons when every crop is in growth.

On the Choice and Management of working Oxen.—Dickson's Agric. Mag. No. 9.

The writer begins by noticing the mistakes made by agriculturists in their attempts to introduce ox-labour, and resolves them into "an improper choice of breed in the animals, a bad mode of working them, and scanty and coarse food;" to some one of which he thinks the disappointment, failure, and dislike to ox-labour may be generally attributed. The long-horned, deep, heavy-shouldered ox is said to be soon fatigued by his own weight, and as unfit for a plough, as a dray-horse for a curricle. Putting too many oxen to the same machine is stated to impede their progress, as well as yoking them to large carts and waggons, with wheels much too high and heavy for them. And their food in winter being chiefly straw, and lying out in the yards, and their being destined to live in the coarsest pastures in the summer, are given as sufficient causes for their being low and out of condition, and not equal to a regular continuance of work.

The breeds recommended, as best adapted for farm work, are the Devon, Sussex, South Hereford, and Glamorgan, or any thin-hided cow-horned kind of Pembroke or Yorkshire, if not too large; these being all nimble active beasts, good walkers, and when turned off, feed kindly. In working them it is advised to provide both yokes and bows, and collars and traces, and to use either the one or the other as may be adapted to the work about to be performed; and to use light waggons and carts on low wheels, those of the carts not exceeding four feet six inches, and of the waggons five feet in height. In ploughing when a long team is necessary in a wet seed-time, it is admitted that collars and trace chains are useful, but this writer has

always remarked that oxen working singly were the poorest, and found that his own suffered considerably if employed so for any length of time. With respect to their food, he thinks it better to keep them rather above their work than below it, having frequently seen loss and disappointment attend low keeping. Green tares, lucern, and meadow grass, mown and thrown into cribs, are recommended to be given in the yard till autumn, and then feed in a good pasture; to take them up early to their stalls at the approach of winter, and to supply them well with hay and straw, and occasionally a few turnips where practicable.

The inability of an ox's working in frosty weather, and to stand the bustle and hurry of a large harvest, equal to horses, is thought to be much against their general use, as well as their requiring rest after baiting in long journies on the road, which a horse will do well without for some time. And the preference given to horse teams is attributed to their ability to do all kinds of work, and at all seasons, and to the great value of, and demand for six-year old horses, in the London markets.

Observations.—The reasons given for the failure of the many attempts to introduce more generally the use of oxen for farming purposes, seem to be founded in extensive observation, and are well deserving of notice. And the instructions given in this short article, apparently founded on experience, will scarcely fail to produce corresponding advantages, if they are steadily pursued in future trials.

On the Cultivation of the Sun-flower, for the Use of Clothiers.—Dickson's Agricultural Magazine, No. 9.

Mr. Saunders, of Stroud, having, in a former Magazine (see p. 91 of this volume), called the attention of its readers to the cultivation of the sun-flower, as a food for swine, and having remarked, that it is cultivated in France for its oil; this writer conceives that it might be successfully cultivated, for the purpose of supplying our clothiers with oil. For, as much of the oil imported from the Levant, under the name of Florence oil, when it becomes rancid, is sold to the clothiers, for the purpose of softening their wool, when preparing for the loom, he conceives, that the oil extracted from the seed of the sun-flower, might be advantageously applied in the same way. The remainder of the paper is confined to observations on the communication of Mr Saunders.

Observations.—The use to which sun-flower oil is here recommended to be applied, seems far more consistent with sober reason

than the enthusiastic flights of Mr. Saunders, which were noticed in the last number of this publication. As the subject seems to have excited, and may yet excite much controversy among the correspondents with the Agricultural Magazine, we avail ourselves of this occasion to take a final leave of the subject, except when, as in this paper, it is stated that the sun-flower may be cultivated for a different purpose from any before recommended.

Description of an improved Threshing Machine, upon a cheap and simple Construction, with Remarks. By J. B. TURNER, *of Miles Hope, near Tenbury.—Dickson's Agric. Mag. No. 9.*

THIS gentleman, having millwrights in his constant employ, about two years since, in erecting the Kidderminster bark-mills, was prevailed on, by some friends, to have a complete set of patterns made for threshing machines, which, when erected, were found completely to answer every expectation. The construction follows:—upon a vertical shaft, about five feet long and twelve inches square, is fixed, horizontally, an iron bevel wheel, six feet diameter, which drives one about eighteen inches diameter, upon a tumbling shaft, about nine feet long and nine inches square; this shaft runs under the horse-path, and extends into the barn, and to the end within the barn is fixed an iron spur wheel, three feet six inches in diameter, driving on about ten inches upon a short iron shaft, which also carries a drum or pulley, three feet six inches in diameter, from which a six inch strap drives one nine or ten inches in diameter, hung upon the iron shaft or spindle, which runs quite through the wood beater or barrel, two feet in diameter, and three feet in length, having fixed upon it, by means of strong screws, twelve wrought-iron bars, about an inch square: the beater making, upon its horizontal axis, about three hundred revolutions in a minute, and consequently about three thousand six hundred strokes in the same time: the corn is conveyed to it by means of a cloth or table, three feet wide and six feet long, and passing between a pair of fluted rollers over a bar, comes in contact with the beater through a cavity, which may be varied by screws, when the straw is immediately delivered, perfectly clean, upon the floor, on the outside of the machine, no more injured for thatch or any other purpose, than by the flail; and the corn, in its passage under the beater, is filtered through a wooden frame to the floor, where it remains. The whole machinery, on the inside of the barn, is stated to occupy a space not exceeding five feet by ten; and on the outside, the vertical shaft having about three feet of the bottom fixed in a pit, below the surface of the ground, is supported at top by a beam or cap, seven or eight feet long, mortised down upon two posts, the size of gate-posts,

standing two or three feet only above the ground: and to the top of the cast-iron gudgeon, which comes from the upright shaft, through the beam, is fixed the draught-pole, twenty feet long, to each end of which the horse-power is applied, which puts the whole in motion.

The advantages, which are stated to be *peculiar* to this machine, are, that it requires no long or large timbers, that it stands in very little compass, without additional building, is readily worked by two horses, cannot be easily injured, can hardly avoid being regularly fed, and threshing from ten to twelve dozen sheaves of wheat in an hour, much cleaner than it could be done with the flail. The expense is stated to be from thirty to forty guineas, in proportion to the weight of iron, brass, and leather, exclusive of timber and setting up.

It is added, that several experiments have been tried upon this machine, in order to ascertain what power, construction, and speed would produce the most beneficial effect: iron fly-wheels have been fixed on the spindle of different diameters and weights, which have been all to steady the work, but to require an increase of power; the beater has been varied both in size and materials, and the velocity both lessened and increased, but the result of these experiments has been found precisely conformable to the well-known principle of mechanics, that weight, velocity, and power can only be prevailed on to act in proportion to each other.

The writer remarks, from all these circumstances, that in his opinion, threshing machines, constructed for and worked by one, and often two horses, seem not to have power enough to do the work well, although they may get some corn through, as the regular working of the machine can only be effected by the extreme efforts of the horse, which he cannot long support. It is recommended, that, where more than one horse is employed, the boy who drives should have a seat upon the draft-pole, by which means he would have all the horses under his eye, and be enabled to regulate their pace more equally and uniformly.

Mr. Turner states, in conclusion, that castings, iron and brass complete (or even the wood patterns), may be had at Mr. Parker's foundery, at Stourport, but he does not know any particular workman, who now professes making and erecting them.

Observations.—The threshing machine, described in this paper, seems well adapted for the purpose; and, from its being more simple, and less expensive than many others, demands the favourable attention of the farmer. It occurs to us, that we have seen a machine at Mr. Pickford's, at Market Street, in Hertfordshire, still more simple, and equally useful, as this of Mr. Turner's contrivance, which was made by Mr. Joseph Frost, millwright, of Great Linford, near Newport Pagnel, Bucks. The threshing machine at Mr. Pickford's, if our memory be correct,

possesses fewer combinations than those made by Mr. Turner, is worked by only one horse, and threshes perfectly clean at least four or five quarters in a day of ten hours, with the labour of two men, and a boy to drive the horse. And as the principle of this machine is so extremely similar to that of Mr. Turner, there is no doubt but that he or any other gentleman might have a machine of the kind, described in this paper, manufactured by the same millwright who made Mr. Pickford's machine.

It may be right to notice, since we are engaged on the subject, that few threshing mills are found to answer in threshing any corn not bound up in sheaves, because the ears of loose corn, passing sideways through the feeding rollers or cylinders, drop through the bottom, before the beaters have separated the corn from the straw, which does not happen to grain bound in sheaves; for, in this case, the straw, entering lengthways, is detained by the rollers so long that the ears are completely cleaned; and we have never seen any machines thresh loose grain clean except those which pass the straw over the drum, and in these the straw is literally cut to chaff, and rendered useless, and the force required to work them is in no case less than a four-horse.

Description of a Machine for cutting or breaking Grain, lately erected by Mr. Wight, at Fillyside, near Edinburgh. By JOHN SHIRREFF.—*Farmer's Magazine, No.* 34.

THIS machine is driven by the vertical shaft of a threshing machine, and is said, by the maker (Mr. Watson, engineer, of Bonington), to be capable of cutting five bolls of oats, wheat, or barley, and seven bolls of peas or beans, in the hour. The cylinder and breast of the machine are both made of malleable iron, case-hardened; the breast, which is nine inches long, four inches and a half wide, and one inch thick, if fixed, being fluted longitudinally, and concave on the side presented to the cylinder. The cylinder is the same length, and five inches and a half diameter, and also fluted longitudinally; the flutes are parallel, having about one-eighth of an inch pitch; and amount to 138. The cylinder performs about three hundred and eighty revolutions in a minute; that and the breast being both placed horizontally, the grain is cut in passing between the sharpened edges of the cylinder and those of the breast. The grain is conveyed to the machine by means of a narrow box from the bottom of a hopper, which drops the corn between the cylinder and the breast. The whole expense of the machine, and erecting it, to be moved by the perpendicular shaft of any other machine, is stated to be £15 sterling.

Observations.—This machine seems better adapted for cutting or breaking corn than the hand-mills usually employed for that

purpose, but the expenses of erection will prove a considerable impediment to its general introduction. It appears deserving of consideration, whether a hand-mill might not be constructed on the same principle precisely, by only using a shorter cylinder and breast-plate.

On the Construction of Drill Machines, with some Observations on Philarator's new-invented Sowing Roller. By L. B.—*Dickson's Agricultural Magazine, No.* 10.

The sowing roller alluded to has been noticed at page 87 of the present volume, has "nothing more than a drill with a roller substituted, to give it motion, instead of wheels." This implement is much commended by the writer of this article, who thinks it likely to supersede the use of most other kinds of drill machines. With respect to drill machines in general, he considers that the high price they bear, and the inapplicability of the same machine to various purposes, without additional and expensive parts, will operate against their extensive introduction. The difficulty of forming a drill, so as to give neither too much nor too little seed, he thinks also, furnishes another objection; since, if too much seed be allowed, one advantage of the drill husbandry is lost, and if too little be given, there will be hazard of a deficient crop; and every practical farmer knows, that the proper quantity of seed for early sowing is not the proper quantity for late sowing. Presuming it will be evident that a machine, which will not sow any quantity of any seed that is required, is unfit for public use; he endeavours to shew, by a long chain of observations, that a machine for drilling seeds is incapable of being brought to such a state of perfection; and laments that those, who are best acquainted with the theory, have in general least knowledge of the practice of agriculture.

Observations.—Though almost the whole of these remarks are well-founded, and apply to the impossibility of making *one* machine answer all purposes of the drill husbandry, in all cases and upon all soils, yet, if absolute perfection is not attainable, the approaches towards it ought not to be disregarded; and if drills cannot be used for all purposes, that circumstance affords no reason why they should not be resorted to for those operations which they are allowed to perform with decided advantage.

Improved Cheese-press, constructed on a neat and simple Principle. By W. N.—*Dickson's Agricultural Magazine, No.* 10.

This cheese-press consists of a box, about fifteen inches and a half square, and thirteen inches deep, to contain stones, iron, or any heavy materials, which is steadily raised and lowered by guiding lines and pullies, between two upright posts, on a stool; and a barrel, with a spur wheel, is so fixed, by the assistance of a third post, that it may be drawn up or lowered with much less labour than is required to manage the common screw cheese-press. It is certainly a useful contrivance, and does not occupy much space, but is incapable of having the same power applied as may be given by a long lever to the screw press.

On the Selecting of proper Hedge Plants, and on the Making of Fences. By W. N.—*Dickson's Agric. Mag. No.* 10.

The idea, that among the operations of husbandry, nothing promotes both the interest and the credit of a farmer more than the neatness of his fences, is given as a reason for obtruding this article on the public. The practice of introducing young oaks, as plants of two years growth, among white thorn, is, in the table of planting, strongly condemned, and it is recommended to procure plants of three or four feet high, but not more, and plant them at the back of the tables of white thorn, on the top of the bank. The writer protests against a custom which is gaining ground in Norfolk, of suffering the ash to become almost extinct, by not planting more, and even by destroying it where it is already planted. Of quicksets, the preference is given to the white thorn, on soils where it is likely to thrive, which will do on all except very rich ones, where holly and crab will succeed better, or those too poor to nourish any thing.

The importance of raising plants for quicksets is next insisted on, both as precluding disappointment to the planter; and as a resource against the exorbitant prices demanded by the nurserymen. The best method of raising briar, holly, and haw, or white thorn, is said to be, having the haws or berries gathered about a month after Michaelmas, and depositing them in a hole in the earth, neither too dry nor too moist, with a little sand strewed at the bottom, and on the top, and then well covering them up with earth higher than the surface: in this pit they are to remain till March in the following year, when they should be taken up and sown in beds about four feet wide; the berries should be sown tolerably thick, and be covered with a full inch of mould: they will make their appearance early in the summer,

and the following year many will be fit for use. Crab-tree plants are obtained by sowing the kernels, or rather the pulp of crab-apples, after the verjuice has been extracted.

The having advanced any thing new is entirely disclaimed, but a due attention to planting, both for fences and for timber, and a due protection of the plants while young, is impressed with an earnestness worthy of the subject.

Observations.—As many husbandmen, who are not really negligent about their fences, are not well informed as to the best mode of constructing them, nor fully aware of the necessity of rigidly guarding them from cattle while young; such persons would do well to pay much attention to the remarks contained in this communication, which are obviously the result of information and experience.

Description of a Hog, of the real Chinese Breed. By Wm. Goodman, *of London.—Dickson's Agricultural Mag. No.* 10.

This animal, which was bred by Lord Hood, was not quite twelve months old when killed, and had not been put to fatten more than five months; and was fed with barley meal two or three times a day. It measured three feet five inches in length, two feet in height, and five feet ten inches and a half round the girth. The weight was sixteen score and two pounds; the head itself weighed twenty-six pounds, and, when separated from the neck, measured fourteen inches across each way; and the bacon was seven inches thick of fat.

Observations.—The real Chinese hog is a rare animal in this country, and its amazing capability of fatness is noticed with a hope, that the pure breed may be more generally and more assiduously attended to by agriculturists. The Tonquin breed of swine was spurious, when first introduced into England, and has so much degenerated by intermixture of blood, as to make it necessary to recur again to China, for the native swine of that country, and the pure breed should be preferred.

On breaking up and converting old Grass Land to the State of Tillage. By N.—*Dickson's Agricultural Mag. No.* 10.

This writer expresses his persuasion, that it is the most prudent economy in agriculture to break up those grounds which have lain many years in grass, and have amassed a considerable

store of the principles of fertility; and at the same time lay down in grass worn-out tillage grounds, that they may in their turn acquire fertility at the least possible expense: and he submits rules for the management of old meadow land, on a clay soil, when so broken up. He advises to plough the land with a regular furrow, having the breadth and thickness in due proportions, and the depth moderate, care being taken to carry off all the stagnant water, and to sow oats upon it as soon as the land is dry enough to admit the harrow. In order to elude the depredations of the earth vermin, the seed should be spread on a damp floor slightly moistened, and a quantity of common salt mixed with it by repeated turnings, so that every grain may be imbued with the melted salt, and this should be done several hours before sowing, and the grain dried with lime, and salt should be sown on the field, at the rate of three bushels to the acre, after the seed is harrowed in, and the harrow should again follow after the salt. As soon as the oats are carried away, it is directed to make preparations for a second crop, by ploughing deeper than before, and bestowing the same care to remove stagnant water, and in the spring to sow beans; in preparation for which the land should be ploughed across as early in the spring as the weather will permit, ploughed again the contrary way, and the beans sown in drills as soon as the land is ready to receive them; the land should be kept perfectly free from weeds during the growth of the crops, and wheat may then be sown after the beans, by giving the land only one ploughing in September, and clover may be sown among the wheat in the spring, and covered in with light harrows, followed by a roller; the clover may be eaten by sheep till the middle of April, when it may, with much profit, be allowed to ripen into seed. If the old turf do not sufficiently rot and decay, lime is pointed out as the best solvent, for this will facilitate the decomposition of the old turf remaining, and at the same time furnish a supply of food for the new crop. In returning the land again to meadow, it is recommended to have the intention in view some years before, that a proper stock of the seeds of the best native grasses and other herbage may be in readiness. It is suggested, that a meadow thus treated, may be restored again to grass in six years, and will then yield more hay, and of a better quality, than before: the land will acquire new principles of fertility, and thus an alternate series of tillage and meadow may be carried on for a very long period without exhausting the soil.

Observations.—Notwithstanding the confidence with which it is asserted, that better meadow and pasture may be obtained, by converting old pasture into tillage for a few years, yet the opinion of all the land-owners in the kingdom (as is evident from their leases) is in direct opposition to this writer, who has only specu-

lative opinion, unsupported by experiment, to oppose to a practice universally followed.

On the Cleansing of Fruit-trees from Moss, by the Use of common Wood-ashes. By an attentive Reader.—Dickson's Agricultural Magazine, No. 10.

The method recommended is to sprinkle, or rather dust the limbs of mossy trees in damp foggy weather, or just after a rain, with common wood-ashes, in consequence of which, it is asserted that the moss will disappear in the course of two or three months, and leave the tree clean and healthy. The best mode of performing the work is stated to be using a large dredger, with holes perforated through the lid, and the most convenient season when the leaves are off the tree, and the moss is wet from the weather. The most complete success is confidently promised.

Observation.—This easy and simple method of removing moss from fruit-trees is deserving of general adoption, when the certainty of the effect has been fully ascertained by experiment.

On the coarse Wool of a Spanish, or Merino Lamb. By Sir Geo. S. Mackenzie, *Bart.—Dickson's Agricultural Mag. No.* 10.

Sir George Mackenzie, having communicated to the editor of the Magazine, a circumstance of a Spanish lamb having been dropped, with a covering more resembling hair than wool, observes, that after a lapse of three months, the hair had entirely disappeared from the neck of the animal, and had given place to wool, but that the rest of the body continued as before. Having had a second lamb dropped in the same hairy state, though got by a very fine ram, he expresses his conviction that the second fleeces of these lambs will be perfect wool, notwithstanding the deviation in the first fleece. The remainder of the paper contains only miscellaneous observations, which have no relation to the subject.

Observations.—The removing the suspense into which the worthy Baronet had fallen, respecting the future fleece of his hairy Merino lamb, may prevent uneasiness to other breeders, who may chance to have lambs dropped in the same predicament. The occurrence is not peculiar to the Merino breed, but sometimes happens in other kinds nearly allied to it, and most commonly in flocks which experience hard keeping during the winter, though by no means exclusively so.

On the Grinding of Apples for the Purpose of Cider. By PHILARATOR.—*Dickson's Agricultural Magazine, No.* 11.

AFTER describing the common mode of grinding apples, by throwing them into a trough, formed by two concentric sides, which thus give circular limits to the intermediate space, wherein a large stone roller revolves on its edge, and crushes the fruit into a pulp, the writer imagines the pulp would be more effectually made by using a roller, which was the frustrum of a cone, instead of a perfect cylinder, because the cylinder, by crushing the apples equally in all parts of the trough, causes them to rise by the sides of the stone, and so avoid its pressure, whereas the frustrum of a cone would drive them first nearer the point of the cone, and then crush them there: he observes, a roller, of the form recommended, is used with success in the manufacture of woad for the dyers. It is also suggested, that if the bottom of the apple-trough was concave in the form of a segment of a circle, and the roller convex to correspond, the fruit would be less liable to escape by the sides. After all, he considers these kinds of mill very imperfect, and very inferior to the hand-mills used for that purpose in the west of England, in which the fruit is conveyed by a hopper, between cylinders of five or six inches diameter, where it is crushed without the possibility of an escape.

Observations.—The fertile mind of the writer in the Agricultural Magazine, who has adopted the signature of "Philarator," manifests its inventive powers in almost every number of that publication. It is worthy of remark, however, that all the implements and machines described by him have no existence, except in his own imagination, and therefore cannot have the test of experience to recommend them. But though his implements have not been embodied in a visible shape, yet his suggestions are well worthy of attention, as practicability of execution seems to be one of the leading features of his contrivances. With respect to the alteration in the apple-mill, hinted at in this paper, it scarcely appears deserving of a trial; for, should it equal his most sanguine expectations, it will still be less useful and more expensive than the Devonshire hand apple-mill, to which he himself gives so decided a preference.

On an advantageous Method of destroying noxious Weeds, especially the wild Onion, as practised in Gloucestershire. By Amicus.—*Dickson's Agricultural Magazine, No.* 11.

The method pursued was to plough well in autumn, manure highly, and sow with rye or winter tares, to be eaten off by sheep in the spring. As soon as the sheep were removed, after undergoing two foldings in June or July, turnips were sown at one ploughing, in rows, about seven inches asunder. In the following spring these were drawn and fed on the land, and spring wheat or barley sown on a five inch furrow. The wild onion is said to have "been beat out of the field" by this mode of cultivation, which is also forcibly recommended on account of the great profits arising from so close a succession of crops.

Observations.—What the mode here described has to do with destroying noxious weeds, and particularly the wild onion, more than many other methods, it would be difficult to discover. The plan, however, is very good in itself, as far as getting a great produce from the ground in a given time, but it seems, from the universal opinion of agriculturists, that few noxious weeds can be completely extirpated, without hoeing or hand-weeding. Perhaps the most effectual as well as the most rational mode of beating these enemies out of the field, as Amicus expresses himself, is to take care that the field be always occupied by useful plants, except when a fallow should be deemed necessary for the destruction of deep-rooted weeds, which cannot be drawn, as couch-grass, &c.

A simple and easy Method of relieving Cattle choked by Apples, Turnips, Potatoes, or other similar Substances, and when hoven by Clover, or other Sorts of succulent green Food; with Remarks on the Cause of the Disease in the latter Case. By N. N.—*Dickson's Agricultural Magazine, No.* 11.

On account of the superiority of this remedy, for hoven cattle, to the one commonly adopted in England, we are induced to notice this article, which is copied from the Transactions of the Agricultural Society of Dutchess County, in America. In those Transactions, the method is thus described:—"Provide a tough piece of grape-vine, about a yard and a half long, and as thick as a man's finger, with a knob, from one to two inches diameter, at the end. Surround this knob with a piece of linen or leather, which, when stuffed with wool or tow, will make a ball of three inches in diameter, and secure it well, so as to prevent its slipping

over the knob: roll it in soft soap or grease, and having secured the creature, and holding out its tongue, thrust the ball down its throat quite into its stomach, and it will immediately be relieved. It is evident how the cure is effected in the case of any round hard substance choking the animal; but to understand how the cure is accomplished when the animal is hoved with clover, or other green food, it must be considered that the cause of this complaint is the fermentation of a large quantity of green food in the first stomach of the animal, on the surface of which a cake, formed by the unchewed leaves, floats, and is pressed by the confined air against the upper orifice of the stomach, so as to stop it completely, and prevent the escape of the least particle of air, which immediately swells the animal, and, unless let out, must destroy it. It is usual to effect this by stabbing near the hip-bone, where the coats of the first stomach adhere to the skin; but the method here described is an easier, safer, and more effectual method; for as soon as the ball is thrust into the stomach, it breaks the cake, lets out the air, and the animal is relieved."

Observations.—This short article, on a most important subject, is recommended to the perusal of every farmer; and when he has read it once he is advised to read it *again*, as the remedy, with the reasoning on which it is founded, can never be too deeply impressed on his mind.

Hints and Remarks on Harvest Work, and the Smut in Wheat. By A. B.—*Dickson's Agricultural Magazine, No.* 11.

The remarks on harvest work approach too near to controversy, and are too personal, to be here noticed; those on the smut in wheat, point out "washing the seed very clean, pickling it, and encrusting the grains with quick lime," as the only preventives of the smut hitherto known or practised. The writer considers it very immaterial which of these operations produce the effect, so long as it is certain that seed thus treated has yielded a crop free from smut, while the same seed, sown without any preparation, has had smut-balls.

Observations.—If treating wheat, previous to sowing, in the manner here recommended, be only a popular prejudice, as many have asserted; it is worthy of recollection, that the error is on the safe side of the question.

On burning Stubble, &c. By A. S.—*Farmer's Mag. No.* 34.

The writer considers it difficult to decide the question, whether the ashes of a burnt vegetable, or the same vegetable reduced to putrefaction, afford most nourishment to plants, and takes notice of the account given by Sir George Staunton, of the southern part of China, where two crops of corn are every summer taken from the same field, the stubble of the first crop being universally burnt as a manure for the second. He also notices the accounts given by other writers, that in the interior of Atrica, the principal manure which a field, destined to be sown with corn, receives, is derived from vegetables burnt on the spot; and observes, that the wonderful effects of paring and burning are every where visible amongst ourselves. A communication to the Board of Agriculture is quoted, in which Mr. Curtes, of Lynn, informs the Board, that he has tried several experiments, which prove to him that burning stubble not only enriches the field, but renders it cleaner, by destroying the weeds; and another communication, wherein Mr. Pontey, of Huddersfield, ascribes the advantage of burning straw on fallows to the effect of heat; a neighbour of Mr. Pontey shelled a considerable quantity of oats at a mill, the husks of which he used to burn, and spread the ashes on his grass lands, but the effect was only observable for one season; but he now spreads them on fallows, and sets fire to them there, and, though the quantity of ashes be trifling, he finds the soil uniformly enriched in such a manner, that though no other tillage be applied, the burnt part may be distinguished from that which was dressed with either lime or dung.

Observations.—We give this paper to the public, not so much with a view of conveying information, as of calling attention to the subject of burning stubble. The method having been adopted by the Chinese, who are universally admitted to excel all other nations in agriculture, is a good recommendation of the plan, which is also strengthened by the observation and trial of some few British agriculturists. As the experiment is attended with neither difficulty nor expense, we recommend it to be made by practical farmers in different parts of the country.

Description of a Feeding Byre (or Feeding House), in the County of Kent. By a Kentish Grazier.—Farmer's Mag. No. 34.

This building is 113½ feet long, 30 feet wide, 20 feet high, under the footing beam, having a floor raised seven feet above the

cattle, by which means a barn is obtained above, as well as a byre (or feeding house) below. This space holds sixty-four cattle, in two rows, their heads facing each other, with a path-way between, four feet four inches wide, to convey their food, &c. The stalls are fitted up in the usual way, with racks for hay and mangers, and their urine is conveyed, by drains, into pits made for that purpose. The barn is made use of as a repository for the food to be given to the cattle, which is let down through trap-doors into small waggons, constructed to pass along the pathway. Against the outsides of the building are placed pens for calves, with a single roof to the side-wall, and at one end, a cottage for a servant, with suitable conveniences for boiling potatoes, &c. It is said, that one man can, *with ease*, feed the whole sixty-four cattle five times a day, turn them out, clean the house, take up the cattle again, and besides, milk twelve cows twice a day, and suckle as many calves; and the editor of the Magazine remarks, in a note, that if one man executes all this work, he is not an idle one.

Observations.—The building here described is certainly very convenient and well adapted for the intended purpose, but it cannot be erected without a considerable expense, at the present high price of materials, of every kind; the floor alone, of the roughest materials, would cost more than two hundred pounds (34 square of naked flooring, and the same quantity of boarding, in a building of 30 feet span). This circumstance must necessarily confine the use of so convenient a building to the opulent farmer and land-owner. The tenant at rack-rent must content himself with conveniences less splendid and less expensive.

On the Management of Bees. By J. D.—*Farmer's Mag. No.* 34.

Taking notice of the observation, that bees are an unprofitable concern in an uncertain climate, the writer is of opinion, that the failure of bees in this island is more to be attributed to mismanagement, and the scarcity of heather (or heath) blossom, which he considers the most necessary of all flowers, than to any irregularity of climate. He relates, that about twelve years ago, he purchased a few hives, and though he resides in a high and cold district of the county of Cumberland, he has uniformly found them profitable. He generally keeps about sixteen hives, and seldom loses any during the winter; he uses square wood boxes, made of fir plank, ten inches square in the inside, and six deep, with three braced laths indented into the top of each box, small interstices being left for the bees to pass from one box to another; and two small round sticks are passed in a transverse

direction to the laths, and about two inches below them, for the purpose of supporting the combs, which are fixed to the laths. The upper box is covered with a piece of square plank, which is taken off when honey is wanted, and, by the comb's being hung to the laths, a separate comb may be taken with as much facility as a whole box. He has found the profits to have amounted to twenty shillings the hive, one with another.

Observations.—The mode of managing bees, detailed in this paper, seems to indicate the necessity of a bee-house, to defend the boxes from the influence of the weather, though such a building is not mentioned. Bees have ever been considered in this country as more peculiarly the stock of the cottager, and the increasing price of honey will probably recommend the care of them more forcibly than volumes written on the subject. The mode recommended, appears to be attended with an expense beyond the means of that class of society, who are the most likely to bestow their care on the management of bees.

On the Blight in Wheat. By Mr. Thomas Davis, *of Horningsham (deceased).—Bath Society's Papers, Vol. XI.*

Mr. Davis commences by observing, that the opinion which he had formerly given to the Society, that the blight in wheat was a *plant*, and not an insect, had been since fully confirmed by the microscopical observations of Sir Joseph Banks, who describes the manner in which the minute seeds of this plant are carried by the wind, and lodged on the growing stalks of wheat, where they take root and vegetate, and, like all other parasitical plants, rob the plant to which they attach of all its nourishment to support themselves: the effect is too well known: it absorbs the farina or flower of the fairest and plumpest grain, and reduces it to a mere shell of bran. The remedy, however, he adds, is not so easily found, and, with all due deference to Sir Joseph Banks, he thinks it very doubtful whether the evil can be eradicated by pulling up the diseased plants, or even by burning all the straw of the blighted crop; for the seeds of this destructive plant are too minute and abundant, and capable of being wafted to too great a distance, to be totally destroyed; a single acre of blighted wheat being sufficient to supply a whole district, and botanists have admitted, that the blight grows and flourishes on other plants besides wheat.

It is not therefore conceived to be within the power of man totally to prevent the ravages of this destructive enemy to agriculture, though it may be obviated in a very considerable degree by ascertaining the causes, which peculiarly predispose and prepare the

wheat plant for its attacks, and these are summed up in one word, namely, *weakness*. That class of plants which the botanists call mosses and lichens, are reckoned by this writer the insects of the vegetable kingdom, destined to prey on weak plants, as insects of the animal kingdom are to prey on weak animals. And in both cases the remedy must be looked for in the natural health and vigour of the object.

He then applies this argument to wheat, by considering the nature of the plant, and the kind of cultivation which usually renders it productive; for as nature has furnished the wheat plant with a double set of roots, so contrived, that the first may be deep enough to enable it to stand the severity of the winter, and the second so shallow as to admit the genial influence of the spring, it first shoots down a perpendicular tap root, to keep it steady during the winter, and, in the spring, tillers out a number of coronal roots, each of which has also its own proper root, and produces its own ear, though still adhering to the former root, and when this operation is complete, the winter root becomes useless and decays; but if the winter root be imperfect, the side shoots will be so likewise, for which reason a strong solid *foothold* for the tap root is necessary for wheat, and the more complete the winter root, the more perfect the crop: in like manner, if the young plants be unequal, so will be the ripening of the crop; and it is generally found that blight takes the crop, while one part of the ears, which is ripe, is waiting for another part which is green.

A *thin* crop of wheat, and a *late-ripening* crop, are said to be the peculiar prey of the blight; and these are generally produced either by sowing the land with wheat which is unfit for it, or in an improper state of cultivation, or by sowing it in an improper season. In short, he gives it as his opinion, that any cause which tends to weaken the plant, will predispose it to receive the blight. Among the most obvious of these are reckoned, 1. Sowing wheat on land that has been so worn out by cropping as to have lost that tenacity and cohesion, which are so necessary to a wheat crop, and which dung, without rest, will not restore:—2. Sowing the land in a light loose state, whereby the plants root too near the surface, and are liable to be injured by frosts, and to have the roots laid bare by the wind:—3. Sowing wheat too late in autumn, especially in poor and exposed situations, where the roots have not time to establish themselves, before winter comes on, and vegetation is at a stand. As these causes appear to him to have occurred more frequently of late years than in preceding times, he thinks there is much probability in the assertion, "that the blight on wheat has increased of late years." For it has not been uncommon to sow land with wheat every third, instead of every fourth or fifth year, introducing in the interim a system of crops exactly calculated to make the land light, where-

by the crops of wheat, though abundant in straw, have not had strength enough to support them till harvest, but have been laid by the rains, and thereby become a prey to the blight. And it has been more the practice lately to sow wheat after turnips, which has been productive of clean crops, but the wheat has been unavoidably sown a month too late, and being consequently late ripe, has been attacked by the blight. Nor has it been an unfrequent practice to sow wheat after potatoes, which is still worse, except in rich deep land, where the plants will grow through the whole of the winter; and the practice of sowing wheat after clover is held to have been carried to too great an extent, as it encourages the slug and the wire-worm, which destroy and weaken a considerable portion of the wheat crop, and necessarily render it more obnoxious to blight.

If then it can be proved (and Mr. Davis asserts that every farmer must have observed it) that all *weak* crops of wheat, and particularly all *late-ripe* crops, are peculiarly subject to blight, he thinks it should be the object of the husbandman to sow *only* such land with wheat as is fit for wheat, to get that ready early in the summer, that it may be close and firm before sowing, to sow as early as the weather will permit, and such kind of seed as will ripen early, and, above all, not to wear out his land by too frequent repetitions of a wheat crop, since not the number of acres sown, but the number of bushels produced, will enrich the farmer and supply the market.

Observations.—These remarks on the causes of the blight in wheat, by a man who joined the best information and the strongest sense to the most extensive experience, are better deserving the notice of the practical farmer than whole volumes by a mere theorist, whatever may he his rank or acquirements. The advice of Mr. Davis, in the last paragraph, can never be attended to without producing corresponding advantages.

On supplying the Poor with Milk. By Mr. Thomas Davis, *of Horningsham (deceased).—Bath Society's Papers, Vol. XI.*

This benevolent writer discusses, in the paper under consideration, the various modes which have been suggested for ameliorating the condition of the poor, and gives the preference to that which he describes. As to the plan of allotting land to labourers, he observes, it naturally divides itself into two modes, either giving them arable land, to raise corn and potatoes, or allowing them meadow land to enable them to keep a cow: with respect to the first, he considers it applicable to very few parishes, at least in the west of England; for it is obvious, that

crops cannot be raised without manure, and a labourer, who keeps neither horses nor cows, makes no more dung than is sufficient for his own domestic garden; besides, the purchase of corn requires a capital beyond a labourer's ability, and perhaps he may be unable to hire his ploughing done. Potatoes may be truly called, in his opinion, the poor man's crop, being the most proper as well as the most beneficial for a labourer, for the planting and digging take place at those times of the year when the farmer's business is in no particular haste, and the hoeing and weeding are to be done when the days are long enough to afford time for those operations before six in the morning, and after six in the evening. With respect to the plan of furnishing meadow land to the labouring poor to enable them to keep a cow, he considers it liable to more objections than the former; for in many parishes it would require more than the whole of the land in meadow, and besides, every poor man cannot purchase a cow; without noticing that the attendance on these cows, and making and stacking hay for them, keeping the fences in repair, and such other work as women and children cannot perform, would frequently take the labourers in husbandry from their masters' work; and labourers in manufactures know not how to do that kind of work, nor could they be spared, if they did.

The Marquis and Marchioness of Bath, properly considering that the poor of Horningsham, adjoining to their seat of Longleat, could easily procure land sufficient for planting potatoes, and recollecting, that the whole which the poor absolutely wanted from a cow, was milk for their children, conceived that the object of supplying them with milk might be fully attained at a much less expense and inconvenience, by keeping cows to furnish them with milk, than by allowing them land to keep cows for themselves. The plan was no sooner conceived than carried into execution, and the poor of Horningsham, who have young children, have been supplied with milk at one penny a quart, for the last five years, with every comfort to them, and at an expense of not more than five shillings per annum, for a family, to their noble benefactors.

Observations.—The mode of diffusing benevolence, pointed out in this paper, does equal honour to the head and heart of those who contrived and carried it into execution. There is no want so severely felt by the poor, or so easily supplied by the opulent, as milk for the nourishment of an infant family, if this mode be pursued, which is also earnestly recommended in a note subjoined by the Bath Society.

On Family-Wine Making. By W. MATTHEWS, *of Bath.—Bath Society's Papers, Vol. XI.*

THIS gentleman presented to the Society at one of their meetings some wine of his own manufacture from the fruits of his garden, which the members present deemed a very good, pleasant-flavoured, and useful article. The expenses of making were from half-a-crown to three shillings a gallon. The practice is recommended to the owners of gardens in general, to all farmers in easy circumstances, and especially to country gentlemen, that, if they do not use it at their own table, they may have the power of furnishing sick and sickly poor persons with such occasional refreshment as they cannot procure for themselves.

The receipt recommended by Mr. Matthews is as follows:—"Take black currants, white currants, red currants, ripe cherries (black heart are the best) and raspberries, of each an equal quantity, though if the black currants preponderate, the better; to four pounds of the mixed fruit well bruised put one gallon of clear soft water; steep three days and nights in open vessels, frequently stirring up the mass: then strain through a hair sieve; the remaining pulp press to dryness: put both liquids together, and to each gallon of the whole put three pounds good rich moist sugar of a bright yellowish appearance, let the whole stand again three days and nights, frequently stirring up as before, after skimming off the top: then turn it into casks, and let it remain full and purging at the bung-hole about two weeks: lastly, to every nine gallons put one quart of good brandy, and bung down: if it does not soon drop fine, a steeping of isinglass may be introduced, and stirred into the liquid, in the proportion of about half an ounce to nine gallons.

Observations.—The practice of making domestic wines from the produce of our gardens is deserving of very general attention during the present high price of those which are imported. Foreign wines are entirely beyond the reach of the poor, and therefore the benevolent will endeavour to supply them, in age and sickness, with the best substitutes which our native fruits will afford. The receipt of Mr. Matthews may produce a very good, pleasant-flavoured, and useful article, but all domestic wines should be manufactured with a portion, though not with the whole quantity, of *loaf* sugar, as possessing the peculiar property of making them sparkle in the glass, whereas moist sugar in a more especial manner gives that richness and body which loaf sugar alone can never supply. An attention to the different properties of the respective sugars will enable every manufacturer of domestic wines to combine them in such proportions as may be most suitable to his own taste. It

does not appear on what principle Mr. Matthews recommends a mixture of both white and red currants, since these differ only in colour and not in quality; a double portion of each sort therefore would produce equally good wine.

On the Cultivation of the Poppy for extracting the Oil. By Dr. COGAN.—*Bath Society's Papers, Vol. XI.*

THE experiment related in this article was communicated to Dr. Cogan in a letter from Ebenezer Hollich, Esq. who resides in the neighbourhood of Cambridge. The latter gentleman passing through Flanders in the summer of 1802 saw several fields of poppies, and learned that they were cultivated for the purpose of expressing oil from their seed for food, and that cattle were fed with the refuse. The oil was however esteemed much inferior to that made from olives, and a gentleman at the table d'hôte at Lisle pushed from him, in the presence of the relater, the oil-cruet, exclaiming, "Ah! it is poppy." Mr. Hollich thought the experiment worth trying in England, and brought over a small quantity of the seed, which he sowed on the first of April 1803. Though it was sown so late in the season it produced a considerable quantity of seed; three bushels and a half of which, weighing 1 cwt. 2 qrs. produced 6 gallons 2 lb. of oil (of the weight of $7\frac{1}{2}$ lb. to the gallon), and 3 qrs. 25 lb. of cake; so that the waste in working was about 12 lb. It was worked three times over; the first run cold 17 lb. the second run cold 19 lb. the third run 11 lb. was heated. From this specimen, and also from a sample of the oil extracted in Holland, which he obtained from Mr. Pugh of Rouen, Mr. Hollich pronounces it by no means equal to olive oil for eating, but thinks it might supply the place of Gallipoli oil, which would be an acquisition to our manufactures, especially in war. He says that he found great difficulty in harvesting the seed; the method pursued by him was plucking it up by the root, setting it upright like beans in the field, and letting it stand for some days; he then brought it to a cloth laid in the field, and beat out the seed, and found that from the opening of the heads the seed would have been lost, if great care had not been taken. It is also stated that in America the large sun-flower is cultivated for the same purpose, but no idea is given how the harvesting can be accomplished without great loss of seed.

Dr. Cogan observes on this statement, that it appears poppy oil is less palatable than he represented it to be in a paper in the preceding volume of the publications of the Bath Society (which was noticed in the RETROSPECT, vol. ii. p. 136); but as there are various degrees of excellency in olive oil, he thinks it may also be the case with oil from poppies, though it is probable that the

latter may maintain a uniformity more than the former, since the olive depends greatly upon favourable seasons for acquiring its pleasant flavour.

Though the domestic consumption of oil among the Dutch greatly exceeds our own, and though they are less delicate in their taste, yet it is asserted as an indubitable truth that poppy oil is frequently mixed with olive, when sold for culinary purposes, as it will correct rancidity acquired by age; and as olive oil is becoming dearer almost daily, it may be desirable to have a substitute though of inferior quality. And if this oil should be disregarded as an article of food, it will not be necessary to have it cold drawn, and then it may be extracted at a cheaper rate for manufacturing purposes; and as the consumption of oil both for manufactures and for lamps is immense, it appears to the writer to be very desirable that we should be strenuous to render ourselves as independent of the continent as possible, since we cannot be always assured of imports equal to the demand. He has been informed that the poppy oil is now used in France, in the counting-houses of the merchants, in preference to any other, as giving a more vivid light, and being much freer from smoky vapour.

Observations.—This communication by Dr. Cogan merits attention in a commercial more perhaps than in an agricultural point of view, for the vast quantity of oil used in the manufacture of wool, the staple commodity of England, almost demands that in the supply of this necessary material we should be independent of foreign nations. The oil from poppies is evidently within our reach, and this has been sufficiently shewn to possess every quality found in foreign oil which is necessary for manufacturing wool: it becomes then an object of national consideration that the poppy, or some other plant which will produce as good oil, should be cultivated on a scale sufficiently extensive to supply our own manufactures. Whether the greater sun-flower (Helianthus annuus) will yield oil of the same quality remains to be proved by experiment, but it seems a more rational cause for the cultivation of that plant, than obtaining its seeds as food for swine or rabbits. The difficulty of harvesting the sun-flower, hinted at by this writer, does not appear to require the care that is necessary to obtain the seed of the poppy, for both ought to be threshed out in the field in the same manner as hemp and flax; and whoever has been conversant in the management of these, would easily surmount every difficulty which presented itself in harvesting the poppy or the sun-flower. We quite agree with Dr. Cogan in the opinion that what is thought excellent palatable food by a Dutchman, does not always maintain the same scale of commendation, when submitted to the decision of an English palate, and we therefore recommend the cultivation of the poppy, and the expression of

its oil, in the most copious and consequently advantageous way, solely with a view to its application in our manufactures, and as affording an excellent material for burning in our lamps.

An Experiment on Soap-suds as a Manure. By Mr. G. IRWIN, *of Taunton; with Remarks by the Rev.* THOMAS FALCONER.—*Bath Society's Papers, Vol. XI.*

MR. Irwin's attention was a few years since attracted to the soil of a garden, which was in a state of great poverty, and his future interest induced him to consider of some means for its restoration. He knew an invigorating manure to be necessary, and it occurred to him that possibly some trivial advantage might be derived from the oil and alkali suspended in the waters of a washing; he therefore caused pits to be made, and the contents of the wash-tub were carefully deposited in them, opening other pits in succession, as washing followed washing, till the whole garden had been watered and enriched, a small part only excepted, which has been left as a visible demonstration of the utility of this manure; for the parts invigorated by the soap-suds equalled in luxuriance the remainder of the fertile vale of Taunton.

Mr. Falconer remarks that this experiment may perhaps remind the agricultural reader of the principal ingredients of the oil compost suggested, in his Essays, by Dr. Hunter of York; for soap-suds contain an animal oil, potash, and water, and Dr. Hunter's compost the same oil and the same alkali, with addition of horse-dung; all however which seems to be gained by the horse-dung is animal oil, of which there is perhaps an increased quantity in soap-suds, after they have been used for the purpose of washing linen. It is asserted that this mixture of an oil and an alkali has been more generally known than adopted, as a remedy against the insects which infest wall fruit-trees; for if the wall be dressed in the early part of the year, it prevents insects from setting on them, and seems, in the opinion of the writer, preferable to the lime-water or wood-ashes and lime, which Mr. Forsyth recommends for the same purpose; as lime soon loses its causticity, and with that its efficacy, by exposure to air, and therefore the application of lime must be frequently repeated.

The practice of Mr. Speechly is quoted, who, in his Treatise on Vines, states having used soap-suds for the destruction of insects with much success; he directs it to be poured from a ladder out of a watering-pot over both trees and wall, but this mode is censured as awkward and wasteful, since a considerable extent of wall may be washed by a common garden pump in a much less time, and with a less quantity of materials.

Observations.—This experiment with soap-suds as a manure shews the advantage of an application of an oil and an alkali, and this mixture seems to be a more useful discovery than Dr. Hunter imagined from the limited scale on which he tried it. It is to be hoped that so valuable a wash as soap-suds will not in future be wasted, since it may be beneficially applied for the destruction of insects on the walls, as well as for manure to the ground.

Saw Machine employed on the Continent, for cutting Fuel-wood. By W. Churchill.—*Dickson's Agric. Mag. No.* 11.

This instrument is said to cut twice as much wood in a day as the common hand-saw, and to be so constructed as to be afforded at a less price. The whole of the iron consists of a saw three inches broad and sixteen inches long, double toothed in the same manner as a gardener's pocket saw, and is fixed in a frame of tough ash, with a cord at the top, in the same way as a saw for dividing blocks of stone, or a cabinet-maker's frame saw for cutting out the legs of tables, chairs, &c. the edge of the saw being broader or thicker than the back, that it may work freely and without clogging.

Observations.—When Mr. Churchill imagined that he was introducing the Parisian frame-saw to the notice of his own countrymen for the first time, he was extremely in error, for the very instrument has been in use more than half a century in the shop of every cabinet-maker, and in a rougher form in the shed of every stone-mason. We entirely agree with him in recommending the frame-saw to more general purposes.

HORTICULTURE.

A short Account of Nectarines and Peaches naturally produced on the same Branch. By R. A. Salisbury, *Esq. F. R. S. &c. —Horticultural Transactions, Vol. I. Part II.*

Though the fact had been long known, that peaches and nectarines are naturally produced not only upon the same tree, but upon the same branch, yet this gentleman could not discover that the fact had been recorded by any author; having, therefore, last year, met with two instances, he gives an account of this anomaly to the Horticultural Society.

It is noticed, that the first instance, preserved by tradition, is found in a letter of the late Peter Collinson, Esq. to Linnè, in which is given an account of a supposed adulterous intercourse

between two apple-trees, standing near each other, in consequence of which one of them bore rough and smooth fruits, in the same manner, it is there said, as a peach-tree that produced both peaches and nectarines. A second instance is said to have occurred at the seat of the late Earl of Burlington, in Yorkshire, which made so much noise at the time, as to have been visited by the late Dr. Richardson, and other celebrated horticulturists. A third is commemorated in a painting of the famous Ehret, now in the possession of Messrs. Lee and Kennedy; and a fourth has occurred more lately, in the garden of William Gilpin, Esq. of which a painting has been made by Mr. Hooker. These are supposed to be the only instances which have occurred previous to the two noticed in this paper: one of these was discovered in June last, on the wall of Sir John Arundel, at Huntingdon, which the writer went to inspect; and after carefully detaching the branch from the wall, he soon satisfied himself that no bud had been inserted; there was, however, only a single nectarine on the tree: the other was in Mr. Wilmot's garden, at Isleworth, which he saw in August last, and learned that this tree, which is the *Royal George*, often produces fruits with both smooth and downy coats, or in fact nectarines and peaches. The list is concluded with the description of a fruit among a number of peaches, sent by James Wyatt, Esq. from the neighbourhood of Hounslow, as a present to Dr. Batty, which possessed the very singular appearance of having one part of the coat smooth, like a nectarine, and the other downy, like a peach.

Mr. Salisbury then proceeds to mention the opinions which prevail among gardeners, as to the cause of these appearances, some of whom attribute it to the pollen of neighbouring nectarine blossoms, being brought by the bees, but he thinks this cannot be the cause, for the fruit is smooth or downy before the impregnation takes place; not that he doubts the important consequences which ensue, when the stigma of one plant imbibes the pollen of another, but he considers these to be manifested only in the succeeding generations. He rather gives credit to a doctrine, first promulgated by Linnè, that varieties, species, and even genera have been produced in this manner. The pith of Linnè's theory is said to be, "that the new vegetable will resemble its father, or that from which the pollen came, in stem and leaves; but its mother, or that upon which the stigma is situated, in fruit and flowers." The cucumber and the melon are cited to shew the necessity of the sexual intercourse in plants; and it is suggested, that, in addition to modern practice, the pollen of all vegetables might probably be preserved from one year to another, and might be found very useful in early forcing, if kept in papers as dry as possible, and not applied till the stigma is moistened with its own natural exudation. And it is said that, in countries where dates are the principal food of the inhabitants, a famine would frequently be the consequence of neglecting this precaution.

Observations.—The account, given in this paper, is deserving notice, rather as gratifying the curious, than as extending the knowledge of the practical gardener. There is no principle laid down on which the certain production of the appearance can be ensured. The theory, quoted from the Amœnitates Academicæ of the great botanist of Sweden, by whose name that system is characterized, which is now adopted throughout Europe, may sufficiently account for new varieties, species, and genera, and has received much illustration from some experiments by Mr. Knight, commuicated to the Royal and Horticultural Societies, which are noticed in this work (vol. iii. p. 413), but it affords no satisfactory solution of a peach and a nectarine being produced on the same branch, for in this case the effect is determined before the cause can operate. It is probably a lusus-naturæ in the vegetable world, in like manner as they sometimes occur in the animal kingdom.

On the Cultivation of the common Flax (Linum Usitatissimum of Linnè), as an ornamental Plant in the Flower-garden. By Mr. John Dunbar, *Gardener to Thomas Fairfax, Esq.—Horticultural Transactions, Vol. I. Part II.*

The object of this paper is to bring into cultivation the common flax, as an ornament of the flower-garden, and also as an object of profit; for this plant, when so cultivated, forms part of the natural riches of a country. As gardening is not in an infant state among us, the writer does not conceive it necessary to give a complete treatise on the culture of this plant, and therefore only notices what is material, with some directions how to prepare the plant after it is gathered, which are offered as the result of several years experience, and by a family of five persons, who had been supplied in this manner with all the linen they required.

After a botanical description of the plant, and a reference to the several publications, where plates of it may be found, Mr. Dunbar proceeds to remark, that the soil of every flower-garden is rich enough to produce good flax; but if it be loamy rather than sandy, the quantity will be nearly double; even in the fields, if cultivated with the nicety of a garden, besides yielding an article superior in quality; for, as the durability of the fibre depends in some degree upon its size, there can be no doubt that tall and vigorous plants are preferable to small ones. It is recommended to dispose this plant in little clumps, of from ten to twenty plants each, towards the back of the flower-borders, and in front of the shrubbery, where it will attain to the height of three or four feet, unless the summer proves uncommonly dry; or it may be employed as a temporary edging, or summer screen, for any particular bed.

The seeds of good flax are described to be short, plump, thick, very oily, and of a bright brown colour; and February, or the beginning of March, is pointed out as the best season for sowing them, though if the ground be sandy, and naturally dry, they may be sown in October or November. The only attention necessary, is keeping down all weeds while the plant is in the seed-leaf. As soon as the seed begins to ripen, and the plants turn yellow, the whole should be pulled up by the roots, and laid in bundles in the sun to be completely dried; the heads then pulled off and the seeds shaken out, and the flax immediately laid to macerate in a ditch or pond of water, and kept under by a piece of timber floating upon it. On the fifth day it should be examined (from which to the tenth day it will be sufficiently soaked); and as soon as the macerated fibres separate easily from one another, it should be spread to dry on a new-mown meadow, after which it only remains to collect it in bundles, and send it to the flax-dresser. Home-spun linen, from such flax, is said to last twice as long as the Irish linens purchased in the shops.

The writer considers it a great error to pull flax so green as is generally done, and a greater to soak it without being previously dried; for, when soaked in that state, the fibres require double the time before they are sufficiently macerated to separate in the dressing.

Observations.—The cultivation of flax in this way will be found to be as profitable as it is easy, and it deserves to be universally adopted. Even the cottager may, in this manner, raise almost enough for the supply of his family, without much encroachment on the ground allowed for his vegetables; and where national utility (and extending the cultivation of flax deserves that appellation) can be combined with ornamental gardening, the more opulent horticulturist, by pursuing the plan recommended, may benefit at the same time both himself and his country.

An Account of the Method of cultivating the American Cranberry, Vaccinium Macrocarpum, at Spring Grove. By Sir Joseph Banks, *Bart. K. B. and P. R. S. &c.—Horticultural Trans. Vol. I. Part II.*

Sir Joseph Banks having cultivated the American cranberry with much success, at his country seat, where it has become an object of importance in the economy of the family, communicated an account of his management of that plant, conceiving it might be acceptable to the Society, and not uninteresting to the public. In describing the place, particular mention is made of a basin of water, in the middle of which an island has been formed by sup-

porting an oak box upon posts, driven into the bottom, in the centre of the pond: this box is circular, 22 feet in diameter, and 13 inches deep; the bottom is placed five feet under the surface of the water, and bored full of holes, and on this a layer of stones and rubbish was first placed, and then a covering of bog earth (brought from Hounslow Heath), which together were five inches below, and seven above the surface of the water in the basin. In the box were planted many curious bog plants, which flourished luxuriantly, and among others the American cranberry. In the autumn of the second year this produced a plentiful crop of fruit, and threw out many runners, resembling those of a strawberry, which took root in the following winter, and in the spring threw out upright branches, about a foot long, on which the flowers and fruit were chiefly placed. The berries were gathered, and found to be very superior in flavour to those imported, which are frequently gathered unripe, and become vapid and tasteless by soaking in the water, in which they are packed. This accidental circumstance determined the worthy Baronet to consider the American cranberry as an article of kitchen-garden culture, and not only to give up the whole island to it, but also to make an additional bed on the side of the pond, 20 feet long and $5\frac{1}{2}$ feet broad, by a few stakes driven into the bottom, parallel to the side, and lined with boards; the bottom of this was also filled with stones and rubbish, and covered with black mould, in the same manner as the island had been; and it was afterwards planted with cranberry plants, which had been previously rooted in a hot-bed, in which they throve most vigorously. The produce of these two plantations, which are 326 square feet, is stated to have been five dozen bottles, besides a basket reserved for present use, in the autumn of 1807; while 5645 square feet of strawberry-beds did not produce a great quantity of fruit; so that the beds necessary to give a sufficient supply of cranberries for the family, did not therefore occupy quite one eighth part of the space allotted to strawberries.

It is also remarked, that during the seven years these cranberries have been cultivated at Spring Grove, the crop has never been diminished from the variation of seasons, the blight, or any other cause; and the fruit has gradually swelled, and duly ripened, without being injured by the attack of vermin, or the excesses of heat or cold, or from those of wetness or drought.

Observations.—The success of Sir Joseph Banks, in the cultivation of a fruit so extremely useful for tarts in the winter, holds out sufficient inducement to other gentlemen, who are fond of a garden, to repeat the experiment. And since the domestic culture of the American cranberry is so readily accomplished, much attention is due to the valuable berries, which may be preserved for use any length of time, without the addition of sugar, till they

are submitted to the culinary process of the oven. Independent of their usefulness for the kitchen, American cranberries will be found to form a beautifully ornamental border to fish-ponds, and basins in gardens.

CHEMISTRY AND MINERALOGY.

On the compound Sulphuret from Huel Boys. By Mr. JAMES SMITHSON.—*Phil. Trans.* 1808.

We have no real knowledge of a compound body until we are acquainted with its proximate or true elements; for what would be our acquaintance with sulphate of iron, if we only knew that it consisted of iron, sulphur, oxygen, and hydrogen? Even bodies totally dissimilar may have the same ultimate elements, and even precisely in the same proportions: nitrate of ammonia and hydrate of ammonia, both ultimately consist of oxygen, hydrogen, and azote.

It is not probable that the compound sulphuret is a direct quadruple combination of the three metals, viz. lead, antimony, and copper, with sulphur; but it may be a combination of the three sulphurets of those metals.

Ten grains of sulphuret of lead produce 12.5 gr. of sulphate of lead; wherefore the 60.1 per cent. obtained by Mr. Hatchett, are equal to 48.08 of sulphuret of lead.

Ten gr. of sulphuret of antimony produce 11 gr. of precipitate from muriatic acid by water; therefore, the 63 per cent. obtained by Mr. Hatchett, are equal to 28.64 of sulphuret of antimony.

The quantity of the sulphuret of copper is evidently the complement of the sum of the others.

As the iron obtained by Mr. H. was clearly adventitious, his proportions are the products of only 96.65 gr. of the ore: which really contains 49.7, or, as we may more justly reckon it, 50 per cent. of sulphuret of lead; 29.6, or rather 30, of sulphuret of antimony; and 20.7, or rather 20, of sulphuret of copper.

All combination, however, seems to be only binary, so that no substance whatever has more than two proximate principles: and therefore, this ore may be considered as a combination of equal proportions, by weight, of *galena* and *fahlerz*; the *galena* itself being composed of 1 part of sulphur with 5 of lead, and the *fahlerz* of 3 parts of sulphuret of antimony, with 2 of sulphuret of copper; the sulphuret of antimony containing 1 of sulphur with 5 of antimony; and the suphuret of copper containing 1 of sulphur and 2 of copper.

The ultimate elements of the ore are therefore 20 per cent. (or 12-60ths) of sulphur; 41 2-3rds (or 25-60ths) of lead; 25 (or

15-60ths) of antimony; and 13 1-3rd (or 8-60ths) of copper: and here, as in calamine, the ultimate elements form sexagesimal fractions of the ore.

These results, deduced from the experiments of another person, appear to corroborate the theory of the proportion of the elements, always forming a simple ratio. Thus 2 parts of lead yield 3 of sulphate of lead, and 5 of lead yield 6 of sulphuret of lead; hence 5 of sulphate of lead may be formed from 4 of the sulphuret. Again, 3 parts of antimony yield 4 of [oxide] *powder of algoroth*, and 5 of antimony yield 6 of sulphuret of antimony; hence 9 of sulphuret of antimony will produce 10 of *powder of algoroth*. The *fahlerz*, or gray ore of copper, in tetraedral crystals, contains antimony, and no material quantity of iron; but probably, some kinds of it contain a smaller proportion of sulphuret of antimony than the *fahlerz* in the preceding compound sulphuret.

None of the figures, given [by Count Bournon] in the Phil. Trans. for 1804, are consistent with nature. The primitive form is evidently a cube, and only one form, a secondary one, has yet been seen, although under two appearances, in one of which the primitive faces form the predominant ones of a prism, in the other, the secondary faces. The faces produced by the decrement of one row, along the edges of the cube, make an angle with the faces of the cube of 135°. The faces produced by the decrement of two rows at the corners of the cube, make an angle of 125° 15′ 52″, with the plane substituted for the edge of the cube. The whole number of faces in these crystals are 50, but none have been found sufficiently perfect to measure the inclinations of the other faces. It is, however, to be presumed that one set of faces results from a decrement of one row, at the corners of the cube, and make an angle of 144° 44′ 8″, with the faces substituted for the edges of the cube; and that two other sets of faces result from a decrement of two rows along the edges of the cube, and form either an angle of 153° 26′ 6″ with the contiguous face of the cube, or of 116° 33′ 54″ with the face of the cube, which is separated by the intervention of that formed by a decrement of one row along the edge.

Observations.—The acknowledged crystallographic abilities of Count Bournon should certainly have led Mr. Smithson to have spoken of his description of the crystals of this triple sulphuret with more respect. Part of the errors he finds in it, is owing to the Count being a follower of De Lisle, who, for want of a knowledge of the calculus, was frequently led to assume a *fundamental* form, different from that which the superior mathematical knowledge of Hauy has shewn to be the *primitive* form.

In the third volume of the Retrospect, p. 425, there were given some observations on Mr. Smithson's hypothesis of the pro-

portion of the elements, and their mode of union. In the present number are to be found the valuable papers of Dr. Thomson, on oxalic acid, and of Dr. Wollaston, on superacid and subacid salts; in which those chemical philosophers develope the theory of Mr. Dalton respecting the combination of the elements of bodies. Some traces of this theory are to be found in Mr. Dalton's paper on the absorption of gases by water and other liquids, of which an abstract is given in the second volume of this Retrospect, p. 178. Although it appears that the ponderable elements of bodies combine in aliquot proportions of the weight of the mass; yet we cannot but think that Mr. Smithson's view of the cause of this effect is far inferior to that of Mr. Dalton. The former seems to think that the atoms of the ultimate ponderable elements of all bodies are of equal weight; so that, for example, we may say that water is composed of one atom of hydrogen, combined with 6 atoms of oxygen. On the other hand, the latter supposes the atoms of the ultimate ponderable elements are of different weights, so that although the weight of the oxygen contained in water is six times the weight of the hydrogen, yet that the water is composed of only one atom of oxygen, united with one of hydrogen, the difference consisting in the weight of the elementary atom of oxygen exceeding that of hydrogen in a sixfold proportion. Although each hypothesis will equally serve to explain the phenomena of nature, and to correct the errors occurring in the manipulations of practical chemists; that of Dalton is probably the real one, because it not only is most agreeable to analogy to suppose that the elementary atoms are of different weight, but also because it is improbable that the same number of atoms of any element, or some multiple thereof, should enter into every combination in which that element is found, as it is actually found that the relative weight of the elementary atoms continues the same, throughout all its combinations.

We have already, vol. iii. p. 425, expressed our opinion concerning the value of the analyses of minerals hitherto made, and therefore need not repeat it. We consider the present explanation of the composition of the Huel Boys pyrites as ingenious and probable.

We are surprised that Mr. S. should use the horrid barbarism, powder of *algoroth*, which has been borrowed from some German nostrum-monger's corruption of the *mercurius vitæ* of Algarotti.

On oxalic Acid. By Dr. Thomas Thomson.—*Phil. Trans.* 1808.

Oxalic acid was discovered by Scheele, but Bergmann first gave an account of its properties. Several chemists have examined the formation of this acid, but have neglected its properties.

The crystals of oxalic acid effloresce by a moderate heat, but recover their original weight in a moist place. They lose about 1-3rd by the heat of a sand-bath; but as the acid itself is volatile, the quantity of water cannot be determined by this process.

Fifty gr. of calcareous spar were dissolved in muriatic acid, the solution evaporated to dryness, and dissolved in water, to get rid of the excess of acid. A solution of 70 gr. of crystallized oxalic acid, dissolved in 600 gr. of water, was gradually added to the muriate of lime, as long as any precipitate fell, but as the muriatic acid evolved retained the last portions of oxalate in solution, the acid was repeatedly got rid of, by adding ammonia, and thus the whole of the lime was precipitated by 558 gr. of the solution, equal to 58.3 gr. of crystallized acid. The oxalate of lime weighed, after being dried in the open air, 76 gr.; but on being exposed for some hours to a temperature of 200° and 300°, only 72 gr. By ignition they were reduced to 49.5 gr. of carbonate of lime, and by a longer calcination to 27 gr. of lime. Hence well-dried oxalate contains 37.5 per cent. of lime, and 62.5 dry acid, and the crystallized acid itself contains 23 per cent. of water. The spontaneous dried oxalate contains about 59.2 per cent. of acid, 35.5 of lime, and 5.3 of water, but sometimes the latter is retained as far as 10 per cent.

A solution containing 9.09 gr. of crystallized oxalic acid, equal to 7 gr. of real acid, in 100 gr. was gradually mixed with 3186 gr. of lime-water, at which time the liquid ceased to alter vegetable colours, and thus 11.2 gr. of oxalate of lime was formed, which left 4.2 gr. of lime on calcination, and corroborated the above statement of the composition of the oxalate. The lime-water contained 1-758th of its weight of lime.

Oxalates of barytes and strontian are white, tasteless powders. They may be obtained by precipitating the earthy muriates by oxalate of ammonia. The superoxalates of these earths are said to be more soluble. Like the oxalate of lime, these oxalates are partly soluble in the strong acids.

Oxalate of magnesia is a soft white powder, like oxalate of lime; it is tasteless, and not sensibly soluble in water. When oxalate of ammonia is added to sulphate of magnesia, there is no precipitation, unless the solution is concentrated.

Oxalate of potash crystallizes in flat rhomboids, commonly terminated by dihedral summits, and having the lateral edges of the prism bevelled. Its taste is cooling and bitter. It dissolves in 3 times its weight of water, at 60°. The superoxalate of potash is sparingly soluble in water, and crystallizes in 4-sided prisms, attached to each other. It contains very nearly twice as much acid in proportion to its base as the oxalate.

Oxalate of soda readily crystallizes. Its taste is similar to that of the oxalate of potash. It loses all the water of crystallization, by heat, and falls to powder.

Oxalate of ammonia crystallizes in long rhomboidal prisms terminated by dihedral summits. One thousand gr. of water, at 60°, dissolve 45 gr.: the specific gravity of the solution is 1.0186.

The composition of these salts was ascertained by adding the bases in solution to a solution of the oxalic acid, with subsequent exsiccation. Oxalate of barytes contained 41.16 per cent. of acid, and 58.84 of barytes. Oxalate of strontian, 39.77 of acid and 60.23 of strontian. Oxalate of potash, 44.87 of acid, and 55.13 of potash. Oxalate of soda, 63.63 of acid and 36.37 of soda. Oxalate of ammonia, 74.45 of acid and 25.53 of ammonia.

Oxalate of magnesia, prepared from the sulphate of that earth, by oxalate of ammonia, exsiccation, and subsequent washing, contains 73.68 of acid, 26.32 of magnesia.

These calculations are independent of the water that may be retained by them, after exsiccation in the steam-bath; but this is probably inconsiderable. In oxalate of potash, thus dried, indeed, there is reason to suspect the existence of 10 per cent. of water.

On precipitating muriate of strontian by oxalate of ammonia, another oxalate of strontian was obtained, which contained just half as much acid as the former, as it consisted of 56.9 per cent. of acid and 43.1 of strontian.

Oxalic acid, when distilled, is only partially decomposed, as some part of it is volatilized unaltered: but with the oxalates, the acids remain fixed, and it is totally decomposed into water, carbonic acid, carbonic oxide, carburetted hydrogen, and charcoal.

The water has always a peculiar smell, and as all the oxalates employed were prepared from oxalate of ammonia, some traces of ammonia were found in it.

The carbonic acid remains partly combined with the base.

The charcoal also remains mixed with the base, to which it gives a gray colour; but if the heat has been violent, no charcoal is found. It therefore probably acts upon the carbonic acid, united with the bases, and increases the quantity of carbonic oxide.

One hundred gr. of oxalate of lime yield 60 cub. in. of gas; of which one part in bulk was carbonic acid, and 3 and an half inflammable air, whose specific gravity was 0.908, and which burns with a blue flame. When mixed with from 1-9th to 5 times its bulk of the oxygen, it may be kindled by the electric spark. The report is the loudest when the oxyen is twice the bulk of the inflammable air. Like all other compound inflammable airs, the results of the experiments differ according to the proportion of oxygen used for the combustion. One part in bulk of gas, and 2 of oxygen, seems to be the best; and the latter ought to contain at least 1-3rd its bulk of azote unless the gas contains much common air. One hundred cub. in. of this gas consume in this manner, 91 of oxygen, and form 93 of carbonic acid, and no other gas;

a result similar to what would take place with a mixture of 70 cub. in. of carbonic oxide, and 30 of carburetted hydrogen. The small difference in the specific gravity may be owing to that of carburetted hydrogen not being exactly determined. Hence this gas appears to consist of 49.27 of oxygen, 42.95 of carbone, and 7.78 of hydrogen.

From an experiment made on 89 gr. of oxalate of lime, the acid of which was decomposed by heat, it was found that the acid yielded 59.53 per cent. of carbonic acid, 24.28 of inflammable air, 11.51 of water, and 4.68 of charcoal. Although this charcoal probably contains oxygen and hydrogen, we must for the present suppose it to be composed of pure carbone, and then the ultimate elements of oxalic acid will be 64.69 per cent. of oxygen, 31.78 of carbone, and 3.53 of hydrogen.

Two other experiments gave nearly the same results, which differ greatly from those of Fourcroy and Vauquelin, as stated by the former, viz. 77 per cent. of oxygen, 13 of carbone, and 10 of hydrogen, but there must be some mistake in their calculation, for the hydrogen would take 60 of the oxygen to form water, and the carbone 33 more, to form carbonic acid; so that the proportion of oxygen assigned is evidently too small, and the remainder must have been furnished by the nitric acid used for the decomposition of the oxalic acid.

It is not enough to investigate the relative proportions by weight of the elements that enter into the composition of a body; but the number of atoms of each element must be determined, as it has been shewn by numerous and decisive experiments that elementary bodies are always in certain relative weights, or in multiples of them. Thus taking the weight of an atom of hydrogen for unity, that of one of carbone will be 4.5; of azote, 5; and of oxygen, 6. Hence as water consists of 1 part by weight of hydrogen, and 6 of oxygen, each particle thereof may be considered as composed of one atom of hydrogen united with one of oxygen.

Carbonic oxide contains 4.5 in weight of carbone, and 6 of oxygen, and therefore each particle is composed of 1 atom of carbone united with 1 of oxygen: while carbonic acid containing 4.5 in weight of carbone to 12 of oxygen, has 2 atoms of oxygen united with 1 of carbone.

Carburetted hydrogen contains 2 in weight of hydrogen to 4.5 of carbone; but olefiant gas contains only 1 of hydrogen to 4.5 of carbone.

Nitrous gas contains 5 in weight of azote to 6 of oxygen; nitric acid 5 of azote to 12 of oxygen; and nitrous oxide 10 of azote to 6 of oxygen.

Numbers may also be affixed to the acids and bases which represent the relative weight of their integrant particles compared with hydrogen as unity. Thus a particle of sulphuric acid weighs 33, of muriatic acid, 18, of carbonic acid, as explained above, 16.5,

of nitric acid as also explained above 17; of barytes 67, of soda 24, of lime 23, and of ammonia 6.

By comparing the proportions of the ingredients in the oxalates, with the known weights of their respective bases, the weight of an integrant particle of oxalic acid seems to be 39.5, and hence it consists of 4 atoms of oxygen, 3 of carbone, and 2 of hydrogen. According to this, oxalic acid ought to contain 61 parts per cent. in weight of oxygen, 34 of carbone, and 5 of hydrogen, a statement which agrees as nearly as could be expected with the former.

As to the decomposition of the oxalic acid by heat, let us conceive 3 particles of oxalic acid decomposed at once, i. e. 12 *o*[xygen]+9*c*[arbone]+6*h*[ydrogen], the products may be estimated as 4 particles of carbonic acid=8*o*+4*c* weighing 66; 2 of carburetted hydrogen=2*c*+4*h*, weighing 13; 2 of carbonic oxide =2*o*+2*c*, weighing 21; 2 of water=2*o*+2*h*, weighing 14; and 1 of charcoal=1*c*, weighing 4.5. The sum of the several ingredients agrees with the composition of 3 particles of oxalic acid, and their relative weight to hydrogen, viz. 118.5.

Hence reducing these proportions to 100 of acid, and joining the two inflammable gases, the decomposed acid ought to yield 55.70 per cent. in weight of carbonic acid, 28.69 of inflammable air, 11.81 of water, and 3.80 of charcoal; which is as accurate an approximation as can be expected to the quantities actually obtained.

When a compound body is decomposed, it is always reduced into integrant particles composed of fewer atoms; thus oxalic acid consisting of 9 atoms is reduced into products none of which contain more than 3 atoms: hence sugar should seem to be a more compounded body than oxalic acid.

Two hundred grains of crystallized sugar treated with nitric acid yield 200 cub. in. of carbonic acid, 64 of nitrous gas, 70 of azote, and 116 gr. of oxalic acid; and hence, supposing the whole of the oxygen in the carbonic acid gas to be furnished by the nitric acid, sugar may be estimated to contain 64.7 per cent. in weight of oxygen, 27.5 of carbone, and 7.8 of hydrogen, which nearly agrees with Lavoisier's statement from another process. The atoms of oxygen, carbone and hydrogen in sugar, will, of course, be to each other, as 64÷6, 28÷4.5, and 8÷1 respectively, so that we may conclude it to consist of 5*o*+3*c*+4*h*, and that the weight of an integrant particle of it is 47.5. It therefore differs from oxalic acid by containing an additional atom of oxygen and 2 of hydrogen. The nitric acid acts on it by removing one half of the carbone in the form of carbonic acid, and the residuum resolves itself into oxalic acid and water. Suppose 2 particles of sugar=10*o*+6*c*+8*h* acted upon; the nitric acid takes off 3*c*, and leaves 10*o*+3*c*+8*h*, or 1 particle of oxalic acid 4*o*+3*c*+2*h* united with 6 particles of water=6*o*+6*h*. Although the forma-

tion of malic acid is said to precede that of oxalic acid, yet the change is ultimately resolvable as above.

Observations.—The principal utility of the present paper is to develope the theory of Dalton, respecting the relative weight of the elementary atoms of compound bodies, and to shew the manner of applying it to the explanation of chemical facts. In this respect, the paper is extremely valuable, and we hope that all future experimenters will adopt the same mode of explanation, which cannot but contribute more to the advantage of chemical philosophy, than any preceding improvement.

In one respect Mr. Dalton seems to have erred: it has been found convenient to refer the ratio of specific gravities, specific heats, &c. to one body, namely water, and although this body is a compound, still we think it would have been more convenient to have adopted it for the standard of the relative weights of the atoms, or as we may justly call it the *atomic gravity* of bodies, than to introduce a new substance, viz. hydrogen.

The paper itself contains hints sufficient for any person moderately skilled in calculation to extend the application of this luminous theory to the discovery of the *atomic gravity* of most bodies, by investigating the analyses hitherto made, and thus enable them to correct those analyses. But in this research care must be taken to avoid the errors that have been introduced into the statements of the composition of many bodies, and particularly into those of the sulphurets and oxides, by several chemical teachers of no small fame, as Fourcroy, &c. and particularly by the translators of Proust's papers into English. This confusion has arisen from the equivocal use of the expression, per cent. in French, which may be reckoned either, to use their arithmetical term, *en dehors*, as is usual with Proust, who says, for example, that in pyrites the iron is combined with 90 per cent. of sulphur, meaning that 100 iron + 90 sulphur = 190 pyrites; or *en dedans*, as is usual in England, when we say that pyrites contains 47.36 per cent. of sulphur, i. e. 47.36 sulphur + 52.64 iron = 100 pyrites.

As it contributes greatly to the understanding of symbols to assume the initial letters or syllables of the words they represent, we were at first surprised that Dr. Thomson should use w, as the symbol of oxygen, which we have altered into *o*. We however concluded that the Greek omega was used in the MS. on account of the identity between a written o and the cypher, from whence some confusion might have arisen, and that this ω has, as in Welsh books, been expressed by w; but as the letter o in printing, and particularly when Italic types are used, is very distinct from the cypher, we think it ought to have been altered before the paper was sent to the press.

On superacid and subacid Salts. By Dr. WILLIAM HYDE WOLLASTON.—*Phil. Trans.* 1808.

DR. Thomson in the preceding paper on oxalic acid has remarked that the quantity of acid in the superoxalates of potash and strontian is just double the quantity of acid in the neutral oxalates.

The same law prevails in other superacid and subacid salts, and these now appear to be but particular instances of Dalton's general observation, that the elements of bodies are disposed to unite atom to atom singly, or if either be in excess, it exceeds in a ratio expressed by some simple multiple of the number of its atoms.

The following experiments afford a proof of this doctrine in the most simple and direct manner.

The gas expelled from 4 grains of carbonate of potash that has been exposed for some time to a red heat, and then enveloped in thin paper and passed up into a tube inverted in quicksilver, by muriatic acid, is exactly equal in bulk to that quantity expelled from 2 gr. of well-crystallized carbonate of potash.

The case is the same when carbonate of soda is employed.

If 20 gr. of carbonate of potash be mixed with 25 gr. of sulphuric acid, and heated till it ceases to boil, and becomes slightly red hot, the residual supersulphate of potash being dissolved in water will be very nearly neutralized by the addition of another 20 gr. of the same carbonate. The small difference that occurs may be fairly ascribed to the trifling quantity of sulphuric acid that remains in the vessel in a gaseous state.

If 2 equal portions of superoxalate of potash be taken, and 1 of them be exposed to a red heat, the residual alkali will exactly saturate the other portion.

Nitric or muriatic acids can take only half the alkali from superoxalate of potash, and leave a quadroxalate that contains 4 times as much acid as would saturate the alkali that remains; for if the salt be redissolved in water and crystallized, the alkali obtained from 30 gr. by ignition is required to neutralize the redundant acid in 10 gr.

This limit to the decomposition of superoxalate of potash is analogous to that of sulphate of potash by nitric acid; for this acid can abstract only half the potash, and converts the remainder into a supersulphate.

Although these modifications are most conspicuous with oxalic acid on account of the slight solubility of its compounds; yet it is probable that the same play of affinities takes place when other acids exceed their base in like manner.

Carbonate of potash was decomposed by oxalic acid, and a sufficient surplus of acid added that it might crystallize in the proportion of 3 to 1: but the first crystals were the common binoxalate, or salt of [wood] sorrel, and the *after* [second] crystals were the quadroxalate. If these two salts could have been separated it would probably have been found that the potash was equally divided between them.

To account for this indisposition to unite in the proportion of 3 to 1, the neutral salt may be considered as $=2p$[otash] $+1a$[cid]; the binoxalate as $=1p+1a$, or $2p+2a$; and the quadroxalate as $=1p+2a$, or $2p+4a$; but as this explanation supposes a double share of the potash in the neutral salt, it is not satisfactory.

The arithmetical relation of the elements will hereafter be probably insufficient to explain their mutual action, and we must also acquire a geometrical conception of their relative arrangement. The most simple hypothesis is to suppose that the limit to the approach of particles is the same in all directions, and that their virtual extent is spherical. In this case, when different sorts combine singly there is but one mode of union. If they combine in the ratio of 2 to 1 they will arrange themselves at the opposite poles of the single one. If there are 3 particles to 1, they may be arranged at the angles of an equilateral triangle in a great circle surrounding the single atom; but this combination will of course be very slight for want of similar matter at the pole of this great circle. If there are 4 particles to 1, a stable combination will take place if the 4 particles are arranged at the angles of a regular tetrahedron. This geometrical arrangement of the primary elements is entirely conjectural, and may perhaps never be perfectly known; yet until it is ascertained how small a proportion the primary particles themselves bear to the interval between them, it may be supposed that surrounding combinations, although themselves analogous, might disturb that arrangement, and in that case, the effect of that interference must be examined before any theory of chemical combination can be rendered complete.

Observations.—This is a proof of the great advantages to be derived from the theory of Dalton, in explaining many abstruse phenomena in chemistry, and in affording a means of correction of the utmost value in practical chemistry.

Unfortunately very few practical chemists are versed in the mathematical sciences, or even understand their own arithmetical expressions of the parts of bodies: a harsh censure, but too true. It was formerly remarked that astronomy and chemistry were in general kindred studies, the observatory and elaboratory being frequently united under the same roof, and alike the alternate study of Tycho Brahe and of Sir Isaac Newton. Astronomy and the mathematics have of late been so extended that they require

the undivided attention of their students; so that most of the modern chemists have arisen out of the medical school of Paris. The *Prælectiones Chemicæ* of Dr. Friend, in which he attempted to give a mechanical explanation of chemical phenomena, are so jejune and unsatisfactory, that no real chemist could give a moment's attention to them, especially as he assumed the identity of the material substratum of all ponderous bodies. Dalton and Smithson have the merit of attempting to correct the processes of the chemists, by arithmetical calculations, but Dr. Wollaston clearly shews, that it will also be necessary to call in the assistance of geometry.

As Dr. Wollaston is almost the only philosopher we know, that is equally well versed in geometry and in chemistry, it is to him, we apprehend, that the world must look for the full developement of the theory of chemical combination. Let us then hope that he will employ the resources of his mind in investigating this theory; and as he is well known to have a degree of chemical knowledge far superior to those foreigners who alone can be supposed capable to contend with him in this research, let us further hope, that as one English philosopher (Newton) has rendered his name immortal, by laying a foundation for explaining the phenomena of the universe, another may be equally successful in explaining the phenomena of chemical combination.

It should appear, that there is some intimate connexion between the primitive form of bodies and the number of atoms of which they consist, and this may induce a suspicion, that each particle of a compound body does not consist of the smallest possible number of elementary atoms; but that they consist of a certain multiple of that number, as the number of primitive forms is so small.

On the Decomposition of fixed Alkalies, and on the general Nature of alkaline Bodies. By Mr. Humphry Davy.—*Phil. Trans.* 1808.

It appeared, from the decompositions and chemical changes produced in substances whose composition was previously known (as related in the last volume, p. 281), that the new electro-chemical method of investigation would lead to a more intimate knowledge of the true elements of bodies: and indeed new and singular results have been obtained from bodies formerly esteemed simple.

When aqueous solutions of potash and soda were acted upon by Voltaic batteries, containing 24 plates of copper and zinc, of 12 inches square, 100 plates of 6 inches, and 150 of 4 inches, charged with solution of alum and nitrous acid, the water of the solution was the only substance acted upon.

Potash, kept in fusion in a platina spoon, by means of a spirit lamp and a stream of oxygen, was a conductor; and being electrified by 100 6-inch plates, a most intense light was exhibited at the negative wire, and a column of flame arose from the point of contact. When the spoon was negative, a vivid light appeared at the wire, but no flame; aëriform globules, that took fire in the atmosphere, rose through the potash. The platina spoon was acted upon by the potash, particularly when it was negative, and particles of it were diffused through the residual potash.

Potash is also rendered a conductor, by being exposed for a few seconds to the open air; and on being exposed on an insulated piece of platina, connected with the negative side of the two batteries of 6 and 4 in. plates, soon began to melt. There was a violent effervescence at the upper surface, but no elastic fluid was emitted by the lower surface. Small globules, similar to quicksilver, appeared; some of which took fire with explosion as soon as they were formed, others remained, and were merely tarnished, and finally covered with a white film on their surfaces.

A similar substance was produced when copper, silver, gold, plumbago, or even charcoal, were employed to complete the circuit. It was also produced in vacuo, as also from potash, melted by means of a lamp in glass tubes, and confined by quicksilver, but the glass was so rapidly dissolved by the alkali that the operation could not be finished.

Soda required stronger electric powers, and the substance produced from it became solid on cooling. A battery of 100 6-inch plates, with the metallic surfaces placed at the distance of nearly $\frac{1}{4}$ inch, could decompose from 40 to 70 grains of potash. The same battery, even when the wires were only $\frac{1}{8}$ or $\frac{1}{10}$ inch distance, could only decompose 15 or 20 gr. of soda. When 250 plates of 6 and 4 in. were employed to decompose soda, the globules sometimes exploded, and separated into smaller globules, which flew through the air and formed beautiful jets of fire.

The decomposition of the fixed alkalies is similar to that of other compound bodies, the combustible base being developed at the negative surface, and oxygen evolved at the positive. Unless an excess of water was present, no gas was evolved from the negative surface.

A white crust was immediately formed on the substance from potash, when exposed to the air, which deliquesced, and the remaining substance decomposed the water, absorbed and separated the hydrogen, until the whole was saturated with oxygen.

In close vessels, dry oxygen was absorbed, but the process soon stopped, as the interior of the globule was defended by the alkaline crust formed on it. The same effects took place with the substance from soda. When these substances were strongly heated with oxygen, at a temperature sufficient for their evapo-

rization, they burnt with a brilliant white flame, and were converted into the original fixed alkalies.

From this speedy union with the oxygen of the atmosphere it is difficult to preserve these substances; naphtha is the fluid that has the least action upon them, and they may be kept under that fluid, in close vessels, for many days.

The basis of potash is imperfectly fluid at 60° Fahr. but at 100° different globules will run into one. At 50° it becomes a soft malleable solid, and about the freezing point of water, it is hard and brittle. Its fracture is composed of beautiful white splendid facets. It is distillable, without alteration, by a heat approaching to ignition. It conducts electricity, and when a spark from a battery of 100 6-in. plates is taken, on a large globule in the air, it burns, at the point of contact, with a green light: a small globule is dissipated with flame and explosion. It is an excellent conductor of heat. It does not sink in rectified naphtha, whose specific gravity was about .770. When globules, measured by a micrometer, were compared with equal globules of quicksilver, their weights appeared to be in the ratio of 10 to 223, at 60° Fahr. so that the specific gravity of the substance was about .6.

When the basis of potash is heated in a quantity of oxygen, not sufficient to convert it totally into potash, and at a temperature below that required for its combustion, it becomes red brown, and when cool, dark gray. This substance may also be formed by fusing together dry potash, and its basis, in due proportions; and it is also often produced, in decomposing potash, when the electricity is intense, and the potash much heated.

The basis of potash burns in oxymuriatic acid gas with a bright red light, and muriate of potash is formed. It seems to dissolve in warm hydrogen, as the impregnated hydrogen explodes when suffered to pass into the air, but it loses this property on cooling, and the basis is deposited.

When the basis of potash is brought into contact with water, an instantaneous and brilliant explosion takes place, and sometimes a white ring of smoke arises, which gradually expands as it rises in the air. When the water is admitted to the basis under naphtha, the decomposition is indeed violent, but not luminous, and hydrogen is evolved. A globule placed on ice, burns with a bright flame, and a deep hole is made, which contains a solution of potash. If a globule of the basis of potash is dropped on moistened turmeric paper, it immediately takes fire, and moves rapidly along the paper, leaving behind it a deep reddish brown trace. It discovers and decomposes the small quantity of water contained in alkohol and ether: as potash is insoluble in the latter, the new-formed alkali renders the ether white and turbid.

The basis of potash, thrown into the common mineral acids, burns on the surface with flame. When it is plunged, by proper means, beneath the surface of sulphuric acid, a white saline sub-

stance, with a yellow coating, is formed, and a gas which has the smell of sulphureous acid. In nitrous acid, nitrous gas is disengaged, and nitrate of potash formed.

The basis of potash unites with phosphorus, under naphtha, and forms a lead-coloured mass, which is only rendered soft by the heat of boiling naphtha. This phosphuret changes into phosphate by exposure to the air; if heated, it emits fumes, but does not inflame till the temperature approaches ignition.

The basis of potash combines with sulphur, in tubes filled with the vapour of naphtha, with emission of heat and light, and a gray substance is formed, which rapidly dissolves the glass, and becomes bright brown. In hermetically sealed tubes no gas is formed, but in a pneumatic apparatus, sulphuretted hydrogen is evolved. In the open air, a violent inflammation takes place, and sulphuret of potash is formed. The sulphuretted basis is gradually converted into sulphate of potash.

Quicksilver instantly combines with the basis of potash, and a considerable heat is evolved. If the basis is about 1-30th of the weight of the quicksilver, the amalgam is hard and brittle. The amalgam, exposed to the air, absorbs oxygen, and forms potash, which deliquesces and leaves the quicksilver pure. It rapidly decomposes water, with a hissing noise, and hydrogen is evolved. It dissolves all the metals, even iron and platina. The basis of potash combines also with gold, silver, or copper, when heated with them in close vessels; these alloys decomposed water, potash is formed, and the metal obtained separate. The alloy of the basis of potash with fusible metal is less fusible than the latter.

Naphtha, that has been exposed to the air, soon oxidizes the basis of potash, and a brown soap collects round the globule. The fixed oils, as also melted tallow, spermaceti, and wax, likewise form a soap with it but slowly, coaly matter is deposited, and carburetted hydrogen is evolved. The first gas emitted is indeed pure hydrogen, arising from the water absorbed by the globule in its passage through the air. The volatile oils are rapidly decomposed by it, potash is formed, charcoal is deposited, and some gas is evolved. Camphor in fusion is rendered black by it, no gas is evolved, and a soap is formed.

The basis of potash reduced the oxide of iron, and still more readily that of lead or tin, potash was formed, and if the basis of potash was in excess, an alloy was formed with the reduced metal.

Flint and green glass are, of course, readily decomposed by the basis of potash, at a gentle heat. At a red heat even the purest glass is altered, the oxygen in the alkali of the glass seems to be divided, one part being taken up by the basis of potash, and the other remaining with the original alkali of the glass; so that by repeatedly distilling the basis in a glass tube, a brown crust, or oxide in the first degree of oxygenizement, not only lines the tube,

but even penetrates the glass. It is also probable that the silex of the glass suffers some change.

The basis of soda is a white metal, like silver; it is much softer than the other metals, very malleable, and may be welded at the ordinary temperature of the atmosphere, by merely pressing two pieces together. A globule of 1-10th or 1-12th of an inch diameter can be easily spread over a surface of 1-4th of an inch, even when cooled down to the freezing point of water.

Electricity and heat are conducted by the basis of soda, and it is inflamed with explosion by the Voltaic spark. Its specific gravity is .9348, as ascertained by that mixture of naphtha and oil of sassafras in which it remains at rest above or below. It melts at 180° Fahr. but remains fixed at the melting point of plate-glass.

It tarnishes, and becomes covered with a white deliquescent crust of soda, by exposure to the air. When heated, the combination is more rapid, but no light is emitted until it is nearly red. The light resembles that of burning charcoal, but is more brilliant: in oxygen, the flame is white, and it throws out bright sparks.

Hydrogen has no action on the basis of soda. It burns with bright red scintillations in oxymuriatic acid gas, and deposits muriate of soda.

When thrown upon water, the basis of soda produces a violent effervescence, and a loud hissing noise, hydrogen is disengaged, and a solution of pure soda is formed. With hot water, small particles of the base are generally thrown out of the water, sufficiently heated to burn in passing through the air. With a very small quantity of water, or with moistened paper, the heat produced is usually sufficient to set fire to the basis.

Alkohol, ether, and the oily bodies, are acted upon in the same manner as with the basis of potash; but the soaps formed by the oils are darker and less soluble.

Nitrous acid produces a vivid inflammation of the basis of soda; but muriatic or sulphuric acids cause the emission of heat, without light. When it is plunged, by proper means, beneath the surface of the acids, it is rapidly oxygenized.

When the basis of soda is fused with dry soda, the oxygen of the latter is divided between them, and a deep brown fluid is obtained, which becomes dark gray and solid, on cooling. This mass is deliquescent, and decomposes water, becoming pure soda. A similar substance is often produced in attempting to procure the basis of soda; and it may also be produced by fusing the basis of soda in tubes of the purest glass.

Sulphur combines with the basis of soda in close vessels, filled with the vapour of naphtha, with emission of light, heat, and often with explosion, and forms a deep gray sulphuret.

The phosphuret has the appearance of lead.

Quicksilver forms a solid amalgam with about 1-40th of the basis

of soda, and the union is attended with much heat. Tin, lead, or gold, may also be alloyed with it. These alloys are soon converted into soda, by exposure to the air. The amalgam seems to form triple combinations with other metals, and in this case iron and platina appear to remain united with quicksilver after the separation of the basis of soda by oxygenizement. The amalgam also forms a dark gray compound with sulphur.

Although the facile combustion of the bases of the fixed alkalies, and the readiness with which they decomposed water, were favourable circumstances for determining the proportions of their *ponderable* constituent parts, yet the action of the bases upon the glass of the tubes, or metals of the trays in which they must be placed, produced great difficulties, as well as because neither water nor quicksilver could be used for filling the apparatus with oxygen. The following experiments on the quantity of oxygen absorbed by these bases, were made, by driving that gas through a tube in which they were exposed on a platina tray by means of a gazometer until the common air was expelled, and then applying heat.

Barometer, 29.6 in. thermometer, 62° Fahr. 0.12 grains of the basis of potash absorbed oxygen equal in bulk to 190 grains of quicksilver.

Bar. 30.1 in. therm. 63°, 0.07 gr. of the basis of potash absorbed oxygen equal in bulk to 121 gr. of quicksilver.

Hence, taking the mean of these experiments, and reducing it to the pressure of 30 in. and temperature of 60°, potash will contain 86.1 per cent. of the basis, and 13.9 of oxygen.

Bar. 29.4 in. therm. 56°, 0.08 gr. of the basis of soda absorbed oxygen equal in bulk to 206 gr. of quicksilver; hence, at the above pressure and temperature, soda contains 80 per cent. of the basis, and 20 of oxygen.

The composition of the fixed alkalies was also investigated, by ascertaining the quantity of hydrogen that was evolved during the decomposition of water by their basis, and their consequent formation.

Bar. 29.6 in. therm. 56°, 0.08 gr. of the basis of potash, amalgamated with 3 gr. of quicksilver, caused the evolution of hydrogen equal in bulk to 298 gr. of quicksilver: this quantity of hydrogen would require for its combustion oxygen equal in bulk to 154.9 gr. of quicksilver, and hence potash appears to consist of 84 per cent. of the basis, and 16 of oxygen.

Bar. 30.4 in. therm. 52°, 0.054 gr. of the basis of soda caused the evolution of hydrogen equal in bulk to 326 gr. of quicksilver: hence soda contains 76 per cent. of the basis, and 24 of oxygen.

Bar. 29.9 in. therm. 58°, 0.052 gr. of the basis of soda caused the evolution of hydrogen equal in bulk to 302 gr. of quicksilver: hence soda contains 77 per cent. of basis, and 23 of oxygen.

From the comparison of these experiments, with several others in which smaller quantities of the bases were employed, it will probably be right to consider potash as composed of 6 parts by weight of the basis, and 1 of oxygen; and soda as composed of 7 parts of the basis, and 2 of oxygen.

These bases seem referable to the class of metallic substances, notwithstanding their low specific gravity; and they may be denominated potasium and sodium, as those names would simply imply that they are produced from potash and soda. This caution is necessary, as the new electro-chemical phenomena may possibly overthrow the *hypothesis* of Lavoisier: and indeed, although the antiphlogistic solution of the phenomena has been uniformly adopted, yet the motive for employing it has been rather a sense of its beauty, than a conviction of its permanency and truth. A phlogistic chemical theory may be defended on the idea that the metals are compounds of certain unknown bases with the same matter as that existing in hydrogen, and the oxides, alkalies and acids, compounds of the same bases with water; but as in this theory a greater number of unknown bases must be assumed than in the modern theory, it would be less elegant.

The experiments in which the alkalies, oxides, and earths, have been said to have been formed from air and water alone, by vegetation, are inconclusive, because even distilled water may contain saline and metallic impregnations, and the open air constantly keeps suspended solid substances of various kinds. In Braconnot's single experiment in close vessels, white sand, cleansed by muriatic acid, was employed, but this process is not sufficient to separate carbonaceous matter from many stones that afford a white powder; and a very small quantity of carbonate of lime may be so covered, as to be scarcely acted upon by acids.

As the fixed alkalies contained oxygen, analogy led to the belief that the volatile alkali might also contain it, as it might easily disappear, when that alkali was decomposed by heat and electricity, and form water, either deposited on the vessel, or dissolved in the residual gases.

Charcoal burned by means of the Voltaic batteries, in very pure ammoniacal gas, deposited a white matter, which effervesced with muriatic acid, and was probably carbonate of ammonia.

Ammoniacal gas, passed over iron wire ignited in a platina tube, not only deposited a sensible quantity of water, but the residual gas was also densely clouded. The iron was oxidized.

In repeating Berthollet's experiments, it appeared that the quantity of hydrogen and azote that was procured, was influenced by many different causes: and ammoniacal gas, prepared from the driest materials, constantly deposits moisture:

Bar. 30.1 in. therm. 56°, ammoniacal gas equal in bulk to 60 gr. of water, expanded, by electrization, to 108 gr. meas. which,

on being analyzed, yielded 80 gr. meas. of hydrogen, and 28 of azote. The platina wire was slightly tarnished. Now 60 cubic inches of ammoniacal gas, under the pressure of 30 in. and at 60°, weigh 11.2 gr. and as 80 cubic inches of hydrogen will weigh 1.93 gr. and 28 of azote 8.3 gr. there was a deficiency of 1 grain, which can only be esteemed to be oxygen: hence this principle must form 7 or 8 per cent. of ammonia, or even more, as the gases evolved may contain more water than the original gas. Ammonia therefore bears the same relation to the fixed alkalies, as the vegetable acids with compound bases bear to the mineral acids with simple bases, and oxygen may be called the principle of alkalescence as well as of acidity.

It would appear from analogy, that the alkaline earths are also compounds of metallic bases with oxygen. Moistened barytes and strontites exhibited, by exposure to strong Voltaic batteries, a brilliant light at both points, and flame at the negative point, but the water might have some influence in this case. Both those earths are non-conductors even when heated to whiteness: on being combined with boracic acid they become conductors, and by electrization they burn with a deep red light at the negative point, but the high temperature has prevented this inflammable substance from being collected.

The idea that muriatic acid, as also the fluoric and boracic, contain oxygen, is strengthened, because, when moist boracic acid is electrified, a dark-coloured combustible matter is evolved at the negative point. Muriatic and fluoric acid gas are non-conductors, but some of their combinations may probably be decomposed by electricity.

The new substances will prove powerful agents in analysis, and from their strong attraction for oxygen may possibly supersede the application of electricity to some of the undecomposed bodies. The basis of potash decomposes carbonic acid, and forms charcoal when heated with carbonate of lime. It is also oxidized in muriatic acid, but the result is not known with precision.

The knowledge of the nature of the alkalies will lead to the solution of many problems in geology, by shewing that agents not hitherto suspected to exist, have operated in the formation of minerals.

Observations.—We consider these ingenious and accurate researches, together with those in which Mr. Davy has since been engaged, as tending more to illustrate the philosophy of chemistry than any thing which has been done since the discovery of the decomposition of water, except perhaps his own experiments on the agency of electricity in chemical phenomena, which are related in the last Bakerian lecture. They enable us to approach very near to a general division of all simple bodies into oxygen,

and oxygenizable or combustible, leaving very few substances which do not derive their principal properties either from a tendency to unite with oxygen, or from their combination with it. Mr. Davy has since succeeded in procuring a pure white metal from barytes, solid at ordinary temperatures, and sinking in water; and he has obtained metallic alloys from lime and strontites, as we believe Berzelius and Pontin have also done in Sweden.

In France, potassium has been obtained in large quantities, without the application of galvanism, by means of the attractions of iron and charcoal for oxygen in a strong heat, and the tendency of the new metal to form an alloy with iron. It is a species of national triumph to see our neighbours continually obliged to follow us in those departments which they once considered as their proper field: it is said that the Great Emperor has now enabled them to construct a gigantic battery at a great expense, and we sincerely hope that it will again enable them to make great discoveries. They have done themselves, as well as Mr. Davy, honour by conferring on him their annual galvanic prize, in consideration of his former Bakerian lecture; and though we expressed our opinion, in our account of that paper, that it deserved to be rewarded by the whole principal of which the annual prize is the interest, according to the conditions upon which that sum was deposited by Bonaparte, yet we do not consider them as having been guilty of actual injustice in withholding it, especially when we take into account the advantage which may still be derived to science from the continued prospect of such an annual remuneration.

In the mean time some of the most accurate of the French chemists have been employed in repeating the experiments on the decomposition of ammonia, and they persist in asserting that it contains not a particle of oxygen. Fortunately, however, for Mr. Davy, the hints of the Swedish philosophers, who imagined that they had obtained a new metal from ammonia, led him to make experiments somewhat resembling theirs, and to employ a globule of mercury as a part of the circuit, in contact with muriate of ammonia: the globule increases rapidly in bulk, and is converted into a soft amalgam; it decomposes water, emitting globules of hydrogen, and affording a solution of ammonia; so that there can be no doubt but that the compound of hydrogen and nitrogen is sufficiently of a metallic nature to form an amalgam with mercury, and that this compound, united with oxygen, reproduces ammonia. Hence Mr. Davy very properly infers, that these gases have no essential distinction from metallic vapours, differing only from the vapour of mercury and of zinc in being gaseous at ordinary temperatures, instead of temperatures approaching to a red heat.

We do not altogether see the necessity of concluding, with

Mr. Davy, that oxygen is the principle of alkalescency as well as of acidity: we are rather disposed to believe that the bases of the alkalies ought to be said to retain their alkaline properties, *notwithstanding* their union with a certain portion of oxygen: that is, we should imagine that they would possess a more powerfully positive electricity in their pure metallic state, although they cannot exhibit the chemical powers usually observed in alkalies while they remain in this state. We also scarcely think Mr. Davy warranted in attributing so much to the possibility of the presence of calcareous and carbonaceous matter in the experiments of Mr. Braconnot.

On Caloric, and the Heat evolved during Combustion. By Mr. James Scholes.—*Phil. Mag. No.* 118.

There are many effects which the present theory of caloric does not pretend to explain, and others which it explains only upon principles inexplicable in themselves. The theory supposes that oxygen in every case unites with the combustible, and that the caloric and light is evolved in consequence of a change in the capacity for heat in the substances before and after combustion. The second part of the theory is doubtful, because when gunpowder is burned in vacuo, caloric ought to be absorbed instead of evolved. Many similar phenomena may be produced.

The Lavoiserian theory very plausibly accounts for the emission of heat and light in common cases of combustion; but the evidence appears merely presumptive, and in many instances it is plain that the heat and light must be derived from some other source.

There appears to be a remarkable relation between oxygen and caloric, or rather the generation of caloric by combustion. The recent experiments of Mr. Davy seem to shew, that combustibles on decombustion absorb the electric fluid, and as no quantity of electric fluid is given out in combustion, it is probably instrumental in producing the caloric of combustion.

There are two electric fluids, one of which (the vitreous) combines only with oxygen, and the other (the resinous) unites with combustibles alone: and caloric is composed of the two fluids of electricity united together. Combustion therefore is the effect of a double decomposition and combination, the electric fluids in some form or another being blended with the atoms of matter, and on being set free by the union of the oxygen with the combustible substance, uniting to form caloric.

As gunpowder therefore contains one of these electric fluids, in large quantities, in the potash, and the other in the sulphur, it is not surprising that it burns in vacuo, or that it gives out so much light and heat on deflagration. Whereas, on Lavoisier's

system we are obliged to suppose an union of oxygen different from its general properties, for no other purpose, but to deceive ourselves.

These principles account in a most simple and beautiful manner for the light and heat produced by electrical experiments and friction. And in like manner, when metals are reduced, part of the resinous fluid which charcoal as a combustible contains is expended in the production of heat and gas, while the other part unites with the base of the oxide, and reduces it to the metallic form. That the new-formed combustible body is sometimes less combustible than charcoal depends merely on the usual variation of properties in the different combinations of the same body; the resinous fluid, or principle of combustion, being more or less fixed in the fire, according to its combination with different substances.

Thus we arrive at conclusions nearly similar to those of Dr. Gibbes, from a very different investigation, and from different phenomena. Some variations in theory indeed exist, especially as it would require farther investigation to admit that water is a simple substance, and the base of both hydrogen and oxygen.

Observations.—The decompositions effected by Mr. Davy, by means of very powerful accumulations of the electric fluids, being similar to the reduction of the oxide of quicksilver, and the other oxides of the more easily reducible metals, by ignition, evidently shew, that the same imponderable agents are common to both; and hence we may conclude that caloric and light are either compounds of the two electric fluids, or that they enter into the composition of those fluids as ingredients, and are evolved during the decomposition occasioned by the electric explosion.

On the Contraction which takes place in Quicksilver at low Temperatures by Abstraction of Heat; and on the Ratio of Contraction between Quicksilver, Alkohol, Water, and Silver. By Mr. John Biddle.—*Phil. Mag. No.* 118.

Some former experiments of the author related in the Phil. Journ. for April 1805, on the specific gravity of quicksilver in its frozen state, being commented upon by Mr. Tardy de la Brossy, in the Phil. Mag. vol. xxiv. p. 322, who supposed that even while alkohol and quicksilver remain in a fluid state, the ratio of their densities might differ when uniformly subjected to the lower degrees of heat, Mr. B. thought it right to investigate the subject by experiment.

The specific gravity of the quicksilver employed was 13.613 at 50° Fahr. that of the alkohol, 0.8141 at 48°; that of very pure silver reduced from *Luna cornea* was 10.225, but on its being hammered, it became equal to 10.362 at 50°. On weighing this silver in water, and in alkohol at various temperatures

from 200° to 56°, the loss of weight was found to be greater as the temperature was less, and of course the specific gravity appeared to be diminished by cooling. Both silver and quicksilver being weighed in separate portions of alkohol, gradually cooled from 100° to 0°, the same result was obtained, which as it opposes a general law that bodies expand by heat cannot be admitted.

This apparent inaccuracy may arise from the contraction of the fluid; but this contraction cannot be investigated by exposing alkohol in a glass tube to different temperatures; for in this case, as the glass itself contracts, we should only acquire the difference of the contraction of the fluid and of the glass, and therefore the hydrostatic balance must be employed; 1000 grains of quicksilver lost 58.3 by being weighed in alkohol at 100°, and 60.7 gr. at 0°.

5276 grains of quicksilver enclosed in the bladder of a rabbit, and weighed in alkohol at 45°, lost (allowing for the weight of the bladder, and the wire by which it was suspended) 319 gr. The alkohol was then heated to ebullition, and afterwards cooled, and it was found that at 135° the quicksilver lost 306 gr.; and at —21° 328 gr.; so that 1000 gr. would have varied in their loss by a variation of 156° of temperature 4.17 gr.

3024 grains of quicksilver enclosed in a bladder, and weighed in water, lost 217.4 gr. at 200°, and 222.1 gr. at 50°; thus there is a variation in the contraction of these fluids in 150° of temperature equal to 4.7; so that 1000 gr. would have varied 1.5542.

1000 grains of quicksilver by being placed in a thin glass vessel along with alkohol, in the centre of a mixture of snow and muriate of lime, was frozen, and suspended to an hydrostatic balance by means of a wire introduced into it while yet fluid; the quicksilver lost 59.9 gr. at the moment it was so nearly fluid, as to have a splendid surface, and the greatest loss after being kept for three hours in a second cooling mixture, was 61 grains.

To ascertain whether silver expanded or contracted by the deprivation of heat; an ingot 16 inches long, 2 inches wide, and $\frac{1}{2}$ inch thick, weighing near 100 oz., was taken and heated to a pale red; an arc of a circle of 15 in. radius was then struck on the silver by beam compasses; and when the silver was cooled to 50°, another concentric arc was struck, by which it appeared that the silver had contracted 1-85th part of its length. The silver was again heated to 200° in water, and left to cool; similar concentric arcs were drawn on it when at 200°, 150°, 100°, and 50°, which shewed that the silver contracted by the deprivation of 150° of temperature, 1-340th part of its length. Now similar parallelopipedons being to each other as the cubes of their homologous sides, by multiplying the specific gravity at 50°, viz. 10.362 by the cube of 341, and dividing it by the cube of 340, we obtain 10.4537, or .0917 for the difference in 150°, that is, .0006114 for the visible contraction of silver in each degree.

Hence the specific gravity of silver at 117° is 10.321; at 50°, 10.362; and at —56°, 10.4268.

Now to discover the real specific gravity of alkohol, or other fluid, by observing the weight lost by silver when weighed in it; divide the quantity of silver (1000), by the weight lost (83.1), at the given temperature (—56°), and again divide the density of the silver calculated, according to its visible contraction (10.4268), by the former quotient; this second quotient (.8665), is the specific gravity of the alkohol, at that temperature. Hence we obtain .0524 for the variation of the specific gravity of alkohol in 106° of temperature, or .00049434 for the variation of specific gravity by each degree. Hence the specific gravity of the alkohol at 117° is .78098; at 50°, .8141; at —56° as above, .8665.

To discover the specific gravity of silver, or other substance, by observing its loss of weight in alkohol, or other fluid, whose specific gravity at any temperature is known; divide the quantity weighed (say 1000), by the loss of weight (83.1) at the given temperature (—56°), and multiply the quotient by the specific gravity (.8665) of the alkohol at that temperature, the product (10.427) is the specific gravity of the silver.

In a similar manner the specific gravity of quicksilver at 200° was found to be 12.407; at 50°, 13.613; and at —56°, 14.465. The difference for each degree being .00804.

And the specific gravity of water at 200° was found to be .8920; and at 50°, 1.0; so that as the difference in 150° is .108, the difference for each degree will be nearly .00072.

From these data, and the ordinary rule of proportion, we may obtain the proportionate contraction of equal volumes of each substance, taking either of them as unity. And if we take the variation of specific gravity in water for each degree of temperature as this unit, that of quicksilver will be 11.1666, of alkohol .6865, of silver .8491. And from these data the proportionate contraction of equal weights of the different substances is easily calculated.

Observations.—Mr. Biddle might have saved himself much labour if he had begun by consulting the tables of expansions which are found in the second volume of Dr. Young's Natural Philosophy, p. 390, 393. The expansion of .00006114 here assigned to silver, is greater than has ever before been attributed even to zinc; and the three authorities quoted by Dr. Young are fully sufficient to supersede these experiments, and to establish the true expansion in bulk at about .000033 for each degree. Hence instead of 10.4268, we have 10.3983 for the specific gravity of silver at —56°, and instead of .8665, .864 for that of alkohol. The expansion of quicksilver, according to the best experiments, is .000104, not .000804, for each degree; and since the variation

must be uniform for the degrees of the mercurial scale, its specific gravity must vary between the degrees of 50° and —21° in the ratio of 1 to 1.007384, or 13.613 to 13.713, and the specific gravity of alkohol at —21°, appears from the experiment with the rabbit's bladder to have been .8525. These results, however, do not agree remarkably well with each other; nor does Mr. Biddle appear to be at all acquainted with the great inequality in the expansions of the same liquid at different temperatures from equal increments of heat: so that in fact no reliance whatever can be placed on any of the calculations contained in this paper.

Account of a Shower of meteoric Stones, at Weston in America. By Prof. SILLIMAN *and Prof.* KINGSLEY. — *Phil. Mag. No.* 119.

A METEOR appeared at Weston, about a quarter or half past 6 in the morning, 14th of Dec. 1807. It appeared like a globe of fire about one half or 2-3ds the diameter of the full moon. It rose from the north and proceeded nearly perpendicularly to the horizon, but inclining a little to the west to about 15 short of the zenith. Its progress was not so rapid as that of common meteors and falling stars; a conical train of paler light attended it, waving and in length about 10 or 12 diameters of the body. It did not vanish instantaneously, but grew fainter and fainter. No smell was observed. The appearance of this meteor lasted about half a minute, and in about half a minute afterwards three loud and distinct reports were heard, and afterwards a rapid succession of slighter reports. One person observed the meteor to take, as it were, three successive leaps before its final disappearance.

Several stones fell in six different places, in a line differing little from the course, so that it is probable that the most northerly fell first. These places are principally within the town of Weston, the most remote are 9 or 10 miles distant from each other.

The most northerly of the three principal places, which probably answered to the three loud reports and leaps of the meteor, was about 40 or 50 rods east of the great road from Bridgeport to Newton, on the borders of Weston. It fell upon a granite rock, within 50 feet of a person standing in the road, but, it being still dark, it was not found till half an hour afterwards, when the largest fragment of it, about the size of a goose's egg, was still warm. The remainder was either broken into very small fragments, or reduced to powder. The granite was stained of a deep lead colour. The stone that fell probably weighed about 20 or 25lb. It was suspected that another stone fell in an adjoining field, and that a large mass had fallen into a neighbouring marsh; but neither of these have been found.

The masses that fell at the second explosion were probably those found in Weston, about 5 miles to the south of the former. The fall of heavy bodies was distinctly heard; and a hole was found in the ground about 25 feet from a house, but the inhabitants took very little notice of this circumstance until they heard of the stones that had been found in other parts of the town; which led them, in the evening, to dig up the hole. The hole was about 12 inches in diameter, and at the depth of two feet they found a large mass, from which, as the earth was soft, only a few small fragments had been detached by the shock. This stone weighed about 35 lb. but it was immediately broke to pieces. Six days after, another mass weighing from 7 to 10 lb. was discovered half a mile north-west from the house. It had fallen on a detached piece of gneiss, which it split in two, and by which it was itself shivered to pieces. Another mass of about 13 lb. weight broken only into two principal pieces by having fallen in a ploughed field, was found about half a mile to the north-east of the house. A fifth mass fell at the foot of Tashowa hill, two miles south-east from the house. A smoke was seen to rise from the spot, as also from the hill where another mass was distinctly heard to strike. It was at first supposed that lightning had struck the ground, but after three or four days, a mass was found to have penetrated the ground at the foot of the hill to the depth of 2 feet, the hole was about 20 in. diameter, and its margin was coloured blue from the powder struck off the stone, which was itself broken into fragments of a moderate size, and probably weighed 20 or 25 lb. The stone that fell on the hill has since been found, and weighs 36¼ lb.

After the last explosion, a noise like that of a whirlwind passed along another house, and a streak of light seemed to pierce the ground; at the same time a shock was felt, and a noise like that of a heavy body falling to the earth. Three or four hours afterwards, a spot of ground recently turfed over was found torn up, and many fragments of stone lying about. A ridge of micaceous schistus, inclining to the south-east, was shivered to pieces; the stone forced itself into the earth to the depth of 3 feet, a hole 5 feet in length and 4½ in breadth being torn up, and large masses of turf with fragments of stone and earth thrown to the distance of 50 and 100 feet. The stone was broke into fragments, none of which exceeded the size of a man's fist: it is conjectured to have weighed nearly 200 lbs.

These stones appear to have been covered externally with a thin black crust, which feels rough like fish-skin, and gives sparks with steel. The specific gravity of the stone is 3.6. Its texture is granular and coarse. It cannot be broke by the fingers; the principal mass of the stones is of a leaden colour interspersed with distinct masses, from the size of a pin's head to the diameter

of 2 inches. These masses are entirely white, and resemble the felspar in the porphyry called *verde antico.*

The stones are thickly interspersed with black globular masses, not larger than pigeon shot, which can be easily detached, and are not attractable by the magnet.

Masses of yellow pyrites are also found in them.

The whole is thickly interspersed with metallic points, which appear still more distinct and luminous by a lens. Their colour is whitish, and they were mistaken for silver; but are an alloy of iron with nickel.

After being wet and exposed to the air, the stone becomes covered with numerous red spots, which manifestly arise from the iron.

It appears therefore that these stones are perfectly similar to those described by Howard; and their contents appear from a hasty analysis to be also similar.

Observations.—It is not a little singular that since the fall of stones from the heavens has been credited by philosophical persons, we should have so many accounts of them, from all quarters. The causes of this frequency of the appearance of these meteors are evidently worth inquiring into.

On chemical Nomenclature.—Phil. Mag. No. 120.

The metalline salts are now named upon the supposition that no more than two oxides of any metal can combine with the same acid. The salt in which the oxide has the least oxygen is named as if it was not present, ex. gra. sulphate of iron; the salt containing the other oxide has the syllables oxy prefixed.

This method is deficient because not only several metals combine with 3 or 4 proportions of oxygen, but also because there can be no distinction whether the acid or the oxide has an excess of acid. It would therefore be proper to adopt Dr. Thomson's method of designating the oxides, and say, for example, nitrated protoxide of lead, sulphated deutoxide of lead, and hyperoxymuriated peroxide of lead.

As many substances ranked as simple bodies will now be decomposed, we ought to adopt names for them nearly allied to their present denomination: thus the base of the muriatic acid may be called muria; that of the boracic, borax; that of the fluoric, fluor. It is no objection that borax and fluor were formerly used to signify other substances, they are no longer chemical terms. It is even to be regretted that the base of nitric acid was not called nitre.

Observations.—This is evidently the production of a person completely infected with the outrageous love of change so predominant in the present day. The introducer of this fondness for changing names was Linnæus, and however we may admire his skill in forming the genera, or distinguishing the species of plants; every sincere friend to science must deplore the rashness of him and his followers in altering names that were even in common use. That new plants or other substances ought to be named on the most scientific principles we are perfectly ready to allow; but the rejection of the names already in use, or the rendering of them equivocal by transferring them to some other substances, cannot be defended with any chance of success among the majority of mankind, however it may be adopted by a few devoted followers of a particular person or society.

The chemical innovators, in their rage for alteration and in pursuing the old visionary scheme of a philosophical language, have not attended to one of the plainest, and at the same time justest rules laid down by Linnæus himself, and have formed several series of generic names that differ only in their termination, as sulphur, sulphite, sulphate, sulphuret, and which are therefore peculiarly liable to be mistaken in writing or printing.

The present author would follow Dr. Thomson in a still more egregious error, and distinguish the oxides by the numerical order of their oxygenizement; but will he, or Dr. T. affirm that the series of oxidizement is perfectly known? For should this nomenclature be universally adopted, and any intermediate degree of oxidizement of a metal be afterwards discovered, it is evident that the new oxide must be named according to the order of its discovery, like the satellites of Saturn, or a great part of the series must increase the number of the equivocal terms already introduced. It is certainly proper that the nature of the oxide should be expressed; but the colour of the oxide, or some of its properties, are fully sufficient to distinguish it. In every case, however, there is a dereliction of the boasted conciseness of the new nomenclature.

The excessive inconveniency of the equivocal terms already introduced, as arsenic, cobalt, manganese, antimony, potash, soda, ammonia, magnesia, &c. does not seem to be duly appreciated by the author, perhaps because he reads only in one book, since he proposes to increase their number by adding borax, fluor and nitre to the list. The modern writers on chemistry do not seem to be aware, that they constitute but a very small proportion indeed of the cultivators of that science; and that by far the greater number of chemical students, especially among practical men, are constantly complaining of the difficulty they have of recognising even substances they are well acquainted with under the mask of their new names; or of distinguishing whether the substance which they have been accustomed to understand by a certain name is meant, or some other material.

On an Increase of Temperature produced in Water by Agitation. *By Dr.* JOSEPH READE.—*Phil. Jour. No.* 87.

IT appears, by experiment, that the agitation or friction of fluids can, in contradiction to the received opinion, excite sensible heat.

The temperature of the apartment being 40°, half a pint of water at a similar temperature, was agitated for a few minutes, in a tin bottle, furnished with a thermometer, which being wrapped round with chamois leather, served to stop the bottle. The temperature of the water rose 8°, and continued to rise for several minutes after the apparatus was placed on the table.

The same effect took place, when the communication of caloric from the hands or the body was prevented by the tin bottle being enwrapped with woollen cloth, and the whole placed in another tin vessel covered with three wet towels, which were sprinkled with water during the experiment, and the hands themselves dipped in snow water.

The experiment was repeated with the same effect, in a glass bottle, while a thermometer placed between the bottle and the covering remained unaltered, so that there was certainly no communication of heat from the hands.

What is the cause of this increased heat? Is caloric material, or immaterial? Is friction adequate to account for animal heat?

Observations.—These experiments appear to stand so directly in contradiction to all which have been hitherto made in a similar manner, that it is useless to found any reasoning on them till they shall have been carefully and repeatedly verified by other observers. It may also deserve to be inquired whether the proximity of the actual temperature to the freezing point has any influence in modifying the effect of friction.

No argument can be drawn from the production of heat by the internal friction of water, which might not be still more strongly supported by Mr. Davy's well-imagined experiment on the friction of two pieces of ice, which were thawed by the heat produced, while the temperature of the surrounding atmosphere continued below the freezing point. And the velocity with which the blood circulates in the extreme vessels appears to be too small to be sufficient to account for the production of the heat of an animal, even if it were established that a certain degree of heat is produced by the friction of fluids. Perhaps the experiment might be varied with advantage by forcing a fluid with great violence through a sponge or some other porous substance of a harder nature; and Professor Leslie's remark, that heat is produced when water is absorbed by sawdust, rather encourages us to expect some interesting results from such an experiment.

On the Union of Hydrogen with Arsenic. *By Prof.* FREDERICK STROMEYER.—*Phil. Jour. No.* 85.

ARSENICATED hydrogen gas is best obtained by digesting an alloy of 15 parts of tin with 1 of metallic arsenic in concentrated muriatic acid, by which means a very pure oxymuriate of tin is obtained. The fetid gas obtained in the common dissolution of tin is also arsenicated hydrogen.

The arsenicated hydrogen gas may be partly reduced to a liquid form by being immersed in a mixture of snow and muriate of lime. The smell of the gas is not alliaceous, but highly fetid and nauseous. Birds were killed in a few minutes in air containing 1-10th of this gas. Venous blood absorbed it, became black in a few minutes, and in 6 or 8 hours metallic arsenic was deposited on the surface. It has no action upon syrup of violet, infusion of litmus or of turmeric, litmus or turmeric paper, infusion of galls, alkaline sulphurets or hydrosulphurets, the alkalies, nor water freed from air by long ebullition. If the water or gas contain atmospheric air, the hydrogen is left pure, and the jar is coated with metallic arsenic and its brown oxide.

The gas burns in contact with atmospheric air, and leaves a thin coat of arsenious acid and brown oxide of arsenic on the vessel. Mixed with twice its bulk of atmospheric air, it leaves arsenious acid and water: with six times, it will not take fire. Equal quantities of the gas and of air cannot be fired by the electric spark.

Equal bulks of the gas and of oxygen detonated violently with the electric spark, and left water and arsenious acid: with an half or one third of oxygen oxide of arsenic likewise is formed, and some metallic arsenic. With five parts of oxygen it burns without detonation. A cubic inch of hydrogen saturated with arsenic required 0.72 cub. in. of oxygen gas for its combustion. Arsenic acid is never formed in these processes.

Nitric acid decomposes the gas. Metallic arsenic is separated, but is quickly oxided by the nitric acid, and at last acidified; the nitric acid becomes yellow, and emits nitrous oxide which mixes with the residual hydrogen. By this means it was ascertained that the gas contains 10.6 of arsenic and 0.219 of hydrogen.

Nitrous acid decomposes it, and arsenious acid is deposited.

Liquid oxy-muriatic acid decomposes it, metallic arsenic and its oxide being separated, and also some of the hydrogen. Oxy-muriatic acid gas brought in contact with it in a narrow tube has the same effect as the liquid acid; but in a wide jar, a white cloud of arsenious acid is instantly formed, as also water, and part of the hydrogen left pure.

The sulphuric, phosphoric, and arsenic acids, slowly decompose this gas, and metallic arsenic is mostly deposited.

In the decompositions of this gas by acids, its volume is increas d at the commencement of the process.

Most solutions of metals in acids also decompose this gas, pure hydrogen is separated, and for the most part metallic arsenic; but if the acid have a weak attraction for oxygen and the oxide, or if the dissolved metal be highly oxided, the metallic arsenic is soon converted into an oxide or an acid. The corrosive muriate of quicksilver is converted into mild muriate, and is such a sensible test of arsenicated hydrogen as to be affected by it even if the gas is mixed with 10,000 times its bulk of atmospheric air, or of hydrogen.

The gas being confined over essential oil of turpentine for ten hours was decomposed, the hydrogen being left. No deposit was formed, but the oil appeared milky and viscous, and after some time small hexaedral crystals terminated by pyramids were found adhering to the vessel. These crystals burned like oil of turpentine, with a strong scent of arsenious acid. The same appearances took place on passing the gas through oil of turpentine.

Observations.—The existence of this compound gas is already well known to chemists; but Professor Stromeyer appears to have examined its properties, and ascertained the proportion of its component parts, with more accuracy than former observers. Besides arsenic, zinc and iron are also capable of combination with hydrogen; and in forming compounds of this nature, as well as in the power of uniting with phosphorus and sulphur, hydrogen exhibits a strong analogy to metallic substances in general, with which, according to Mr. Davy's opinions, it seems to have some pretensions to be classed.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

Calculation of the Rate of Expansion of a supposed lunar Atmosphere. By a Correspondent, "HEMEROBIUS."—*Phil. Jour. No.* 87.

IT has been supposed by some philosophers, that if the moon had possessed an atmosphere equally dense with that of the earth, it would in a short time have expanded so much in the part immediately turned to the earth, that the greatest portion of it would have come within the reach of the earth's superior attraction, and been added to the terrestrial atmosphere. The author of the present paper has undertaken to inquire into the foundation of this

opinion; and the task does not appear to be by any means an easy one. He finds in the first place, by a fluxional calculation, allowing for the effect of the centrifugal forces, that the density of an atmosphere extending from the earth to the moon would be less at the moon's surface than at the earth's, in the ratio of unity to that number, of which the hyperbolic logarithm is 685.69; and where the density is least, in the ratio of unity to the number of which the hyperbolic logarithm is 724.31. He then proceeds to calculate the rate of expansion of the lunar portion of this atmosphere, supposing it to terminate abruptly at the point of least density; and for this purpose, he lays down a general law, "that the motion of the centre of gravity of any system of bodies, some of which are urged by a greater force in one direction than in another, must be the same as if the difference of the forces acted on the whole system, collected into the centre of gravity." Hence he finds, that the ascent of the centre of gravity of a column of such a lunar atmosphere would be only 514 feet in a whole century. Again, in order to estimate the effect of such an elevation, he finds it necessary to determine the actual height of the centre of gravity of a column of an elastic fluid: and by means of a compendious expression for a hyperbolical logarithm lately published, he shews that the height of the centre of gravity is equal to that of a uniform column of the atmosphere, capable of producing the pressure: and after some corrections and allowances, he concludes that the rarefaction of the lunar atmosphere in the first century of its expansion would amount to about $\frac{1}{1200}$. The contraction of the visible portion of the atmosphere, produced by this change, would be only 120 feet on each side; and this would certainly be imperceptible to us, who are situated on the earth. But in order to examine how far it might be observable from the refraction of the lunar atmosphere in occultations of stars, the author inquires into the magnitude of the refraction of a lunar atmosphere equally dense with that of the earth, which would not, as appears at first sight, be equal to the refraction of the terrestrial atmosphere; but instead of 66′, would be only 13′ 50″, and $\frac{1}{1200}$ of this would be still imperceptible; although, in the course of a few centuries, the rarefaction might perhaps be much more easily observed in these phenomena, than from the immediate decrease of the visible extent of the luminous disc. The author thinks, however, that 10,000 years could scarcely have been sufficient to reduce the lunar atmosphere from such a density to its present state.

Observations.—In these calculations, intricate as they appear, the author seems to have shewn some degree of address in stating the subject in its simplest point of view: the general principle by which the expansion is determined, is employed in a new man-

ner; and it might be supposed that it is capable of being applied with advantage to many other cases of the motions of fluids; but the difficulty would often be to determine what portion of force is actually exerted in a given direction, for it seldom happens that this determination is directly practicable. The expression for the logarithm is taken from a short paper of Dr. Young on Dubuat's theorem, which we have already noticed (volume iii. p. 537); and it affords a solution without the use of a series, which Simpson has employed in a similar case: and the refractive density is determined in a very concise manner by the assistance of a formula, of which Simpson was the original author, but which is not here expressly quoted. On the whole, there is reason to think that the inferiority of the moon's attractive powers is in some manner concerned in the rarity of her atmosphere, although the earth might not have been able wholly to have deprived her of a much denser one, even if the air had been infinitely expansible, without any limit from the magnitude of its constituent atoms.

On the Application of the Gas from Coal to economical Purposes. By Mr. William Murdoch.—*Phil. Trans.* 1808.

The facts here related are founded on observations made at the cotton manufactory of Philips and Lee, at Manchester; the whole of which, as also the dwelling-house of Mr. Lee, is lighted with this gas.

The coal is distilled in large iron retorts, and the gas is conveyed into large gazometers, where it is washed and purified, and from whence it is conveyed by pipes, forming a total length of several miles to the burners. The supply of gas is regulated by cocks. There are 271 burners on the principle of the Argand lamp, each of which gives a light, as measured by means of shadows, equal to 4 mould candles of six to the pound; and 633 burners, called cockspurs, having 3 apertures only of 1-30th of an inch, and of which the light is equal to 2 and a quarter of the same candles; so that the whole of the light is equal to 2500 candles of that size, each of which consumes 4-10ths of an ounce, or 175 grains of tallow in an hour.

The quantity of gas required for this number of burners is 1250 cubic feet in an hour. In some mills where there is overwork, the light will, on an average of the whole year, be required for 3 hours, and in a few, where night-work is still used, 12 hours; but in this manufactory, the yearly average is only 2 hours a day, or 2500 cubic feet of gas. This quantity of gas required the distillation of 7 cwt. of cannel coal; for this species of coal, notwithstanding it cost eight shillings, was used, as it not only

yields a greater quantity of the gas than common coals; but also of a superior quality.

The expense of the lights used in this manufactory, may therefore be thus stated:

Cost of 110 tons of best Wigan cannel, at 22*s.* 6*d.* is -	£125
Cost of 40 tons of common coal, to heat the retorts, at 10*s.* is - - - - - - - - - -	20
	145
Interest of capital, and wear and tear of the apparatus, which is, however, larger than necessary - - - - -	550
Attendance, the same as when candles are used, and therefore need not be stated - - - - - - - -	0
	695
Deduct value of 70 tons of good coak, at 1*s.* 4*d.* per cwt. is - - - - - - - - - -	£93
Value of 1250 ale gallons of tar; not yet sold - - -	0
	— 93
Yearly expense	£602

The expense of candles to give the same light would be, at 1*s.* per lb., nearly 2000*l.*

If the light were required for 3 hours a day, the advantage would be still greater, as the interest of capital, and the wear and tear, remain nearly as before; so that the yearly expense will not be more than 650*l.*, while that of tallow would amount to 3000*l.* If the light were required for more than 3 hours, an increase of some parts of the apparatus would be required.

If the comparison is made with oils, the advantages would appear less.

The light was at first attended with some inconveniences from the smell of the unconsumed gas, or that imperfectly purified; but by successive improvements in the apparatus, and the greater skill the operators have acquired, these have been obviated. The light is peculiarly soft and clear, and of almost unvarying intensity, so as to be very pleasing to the workmen. It is also free from the danger of sparks.

Sixteen years ago, in making experiments on the quantities and qualities of the gases from mineral and vegetable substances by distillation, and being struck with the great quantity of gas afforded by coals, and the brilliancy of its light, several experiments were instituted in order to estimate the expense with which the light might be obtained compared with that of oils and tallow.

In 1798, on removing from Cornwall to the Soho foundry, an apparatus on a large scale was constructed, and the gas applied to light some of their buildings; and various new methods of purifying the gas were tried. On the peace of 1802, Mr. Boulton's

manufactory was illuminated by means of this gas, and it has since been applied to give light to all the principal shops there.

At the commencement of Mr. Murdoch's experiments, the observations that had been made on the combustibility of gas from coal were unknown to him; but Dr. Clayton, in the Phil. Trans. for 1739, has related some experiments to that effect: the idea, however, of applying it as a substitute for oils and tallow, and still less the actual employment of it, was reserved for Mr. Murdoch.

Observations.—In the first volume of the Retrospect, p. 130, there were given several observations on this subject; and the same subject was resumed in the third volume, pp. 11 and 83, where the fallacious proposals of Mr. Winsor were fully exposed.

The present communication furnishes the necessary data for calculating the quantity of coals that would be required to yield a light equal to a given number of candles; and it affords an easy means of investigating the economical advantages of this process, which seems well adapted to the illumination of public buildings, large manufactories, and, generally speaking, all establishments where a great number of lights are required: but we fear that the expense of the apparatus will always be against its introduction in domestic establishments on a small, or even middling scale.

An Inquiry into the Causes of the Decay of Wood, and the Means of preventing it. By Dr. PARRY, *of Bath.—Bath Society's Papers, Vol. XI.*

THE object of this paper is to suggest the best means of preventing the decay of wood, chiefly by inquiring into the nature and sources of the evil, against which it is intended to guard.

Wood, when killed, by being separated from its root, is stated to be subject to gradual destruction, from two causes,—rotting, and the depredations of insects. Of the rot there are supposed to be two kinds, one which affects wood in the open air, and the other which affects it under cover, and is commonly known under the name of the dry rot.

As animal and vegetable substances possess certain common properties and movements, which constitute what is called life, so the writer considers them subject to the chemical and mechanical laws of all other matter. When perfectly dry, and in certain degrees of temperature, both seem to him to be scarce capable of spontaneous decay, as is instanced in the salmon conveyed in a frozen state to London from the north of Scotland; so

likewise, in the burning climate of Africa, when it is necessary to preserve a dead animal for food, all that is requisite is to cut the muscular parts into thin strips, from which the sun quickly exhales the moisture, and reduces them to a substance like leather or horn, which is not subject to decay from putrefaction. It is asserted, that similar causes produce the same effects on wood, even under less rigid circumstances; and as an instance of this he quotes Westminster Hall, the roof of which was put on in 1397, and the gates of old St. Peter's church, at Rome, which were said to have continued without rotting from the time of Constantine to that of Pope Eugene IV. a period of eleven centuries. Wood also will remain for ages, if continually immersed in water, or if deeply buried in the earth or in morasses; from which circumstances he infers, "that if the access of atmospherical air is not necessary to the decay of wood, it is at least highly conducive to it."

And since it is constantly found that in posts fixed in the ground, and exposed to the weather, that part decays soonest, which is just above or within the ground, and that where there is an accidental hole, or artificial cavity, as in a mortise and tenon, there the wood universally begins first to moulder away, he concludes, "that the great cause of decay is the constant action of water aided by air, which most affects those points where it is most retained, but has less operation where it chiefly runs off by its own gravity. The change described is stated to be the consequence of putrefactive fermentation, a chemical operation, in which the component parts of the wood form new combinations among themselves and with the water which is essential to the process; but it is admitted that the precise nature of these compounds has not been ascertained.

Besides this, water is also said to destroy wood exposed to the open air, by a mechanical operation; for, in winter, not only the earth of fallows moulders down, but porous freestone splits and shivers, which effects are produced by frost acting on the water in the pores or interstices of these substances, where, being converted into ice, it bursts the minute cells in which it is contained; and no doubt is entertained but a similar operation takes place to a certain extent in exposed wood, and in some degree promotes its destruction.

From these premises it appears conclusive to Dr. Parry, "that the contact of air and water is the chief cause of the decay of wood; and that if, therefore, any means can be devised, by which the access of moisture and air can be prevented, the wood is so far secure against decay." He illustrates this position, by supposing a cylinder of dry wood to be placed in a glass tube, which it exactly fills, and which is hermetically sealed, and doubts not but such a piece of wood would remain unchanged; and by noticing the case of amber, in which a variety of small

flies, filaments of vegetables, and other fragile substances, are found embedded, and have been preserved from decay for a thousand years, and with no apparent tendency to change in ten times that period. "Let us see then," says he, "if we cannot, by the exclusion of moisture and air, find means of virtually placing our timber in a case of glass or amber."

The various expedients employed to preserve wood are then noticed, of which the most common is paint, and the mode in which this application serves to preserve the wood from destruction is pointed out to be by forming a crust which is with difficulty penetrated by moisture or air, though this effect frequently fails where too much oil of turpentine is used, for this is imbibed into the pores of the wood, and instead of forming a crust with the white lead, leaves the latter on the surface, which comes off in a dry powder, like whiting, as if the vehicle which glued it to the wood had been decomposed and lost, leaving only the pigment behind. This failure is suspected to arise from the unctuous oil having its tenacity or thickness too much opened by the oil of turpentine, for the unctuous or fat oils are much changed in their properties by the admixture of the volatile essential oils. It appears, therefore, to the writer, that these drying oils, either by themselves or boiled with metallic oxides, will form a varnish on wood; but he considers it very questionable how far the colouring materials contribute to their preserving power: for, that they do not enable the oil to lay firmer hold on the wood is evident, from the observation, that paint on street doors, which is become thick by frequent incrustation, is apt to rise in large blisters, from the strong influence of the summer's sun; here, therefore, the colouring matter of the paint fails to produce the desired effect; and it is suggested that increasing the thickness of the covering may be more effectually accomplished, than by increasing the quantity of pigments, which are capable of chemical decomposition. Road-dust is said to have been recommended for this purpose, by an ingenious artist, but, however just the principle, the application is characterized as somewhat unphilosophical, unless it be found that dust of every quality will equally answer the purpose.

It is admitted that some material of this kind, if selected with more precision, may be found useful, and none is thought to promise more fairly than silicious or flinty sand, which, as far as we know, is absolutely indestructible, and which may be easily procured from the sea, and the currents of roads and rivers: in using it, however, it should be first cleared from all saline impregnations, by washing in several waters, and any sand may be obtained of the fineness desired by mixing it with water in a tub, and after having stirred the whole well together, pouring out the muddy water, from which the sand will settle, by its own gravity, in a state fit for use, when dried.

Dr. Parry states his attention to have been first attracted to this subject by the circumstance of some water-spouts being taken down, in a state of complete rottenness, though they had been painted and pitched in the common way; and having read that charcoal had come down to us perfectly sound from the time of the Romans, when buried in moist earth, he determined to try an artificial coat of charcoal, and carefully rubbed the new spouts with a coat of drying oil, and immediately dredged them over with a layer of charcoal, finely powdered, and contained in muslin; and in a day or two brushing off what was loose, he painted them in the usual manner, and the whole formed a firm and solid crust; after which the spouts were put in their places, and upon examination, many years afterwards, appeared perfectly sound.

He then examines the circumstances attending the decay of wood under cover, which is called the dry rot, which chiefly affects interior doors, shelves, laths, which subdivide the layers of wine, and all other woodwork in cellars, and the wainscotting of large rooms little inhabited; and notices, that, during the change of all these, a crop of mucor, or mould, and very frequently of fungi, springs from the porous mass, and the decay is attended with a smell not easily described, but which is sufficiently known. The causes of this destruction he conceives to be precisely the same as those mentioned in the preceding case, though their action is differently modified, and that the decay is produced by the putrefactive fermentation of the component parts of the wood, in connexion with moisture; without which he again remarks that wood cannot putrefy; and observes, in illustration, that common air is capable of mixing with water, not only in the form of vapour, but in every state of the atmosphere; and therefore, if a sufficiently cold substance comes in contact with vapour, the superabundant heat, which was necessary to its existence in that form, passes into that cold substance, and the vapour is immediately condensed, or changed into water. Hence it is, that when we breathe upon a looking-glass in summer, it becomes immediately dim, and if we continue to breathe on it, drops of water appear and trickle down; and hence it is that the same thing takes place on the outside of a glass of water from the well, or a bottle of wine from the cellar, when brought into a warm room; and hence likewise it appears to Dr. Parry, that water is generated by the condensing of vapour, which combines with air in bringing about the destruction of wood under cover, or in other words, causing the dry-rot.

Considering then, that both these cases shew the nature of the evil, he apprehends the remedy to be obvious, namely, to prevent the approach of moisture; and this he conceives may be effected by applying a preparation of the resinous kind, mixed with a certain proportion of bees-wax.

The proportion of ingredients, and the mode of mixing them,

recommended by him, are as follow: "Take 12 ounces of rosin, and 8 ounces of roll brimstone, each coarsely powdered, and 3 gallons of train-oil; heat them slowly, gradually adding 4 ounces of bees-wax, cut in small bits; frequently stir the liquor; which, as soon as the solid ingredients are dissolved, will be fit for use."

It is recommended to dress every part of wood-work with this composition, twice over before the parts are put together, and once afterwards, and a higher state of preservation is promised from its use, than has yet been attained.

Observations.—The suggestions of Dr. Parry are entitled to much notice, as he recommends his plan, not only from the philosophical reasoning which theory affords; but in some measure, from practical experience, as in the instance of the water-spouts. The causes of decay in wood are certainly elucidated more clearly in this paper than we remember to have seen in any preceding publication on the subject, and they are uniform, and perfectly adequate to the effect proposed. We cannot too strongly join in Dr. Parry's recommendation of the varnish which he has found so effectual: at the same time, in preparing it, the precaution should be taken of using an earthen vessel, and of making the fire in the open air; for, whenever oil is brought to the boiling point, or 600° of Fahrenheit's thermometer, the vapour immediately catches fire; and though a lower degree of temperature than that of boiling should be used in this process, it is not always practicable either exactly to regulate the heat, or to prevent the overflowing of the materials, in either of which cases the most fatal accidents might follow, if the melting were to be performed within doors.

Description of a Fire Alarm. By Mr. James Phœnix.—*Repertory of Arts, No. 72, Second Series.*

A long-necked retort, whose capacity including its neck is about three pints, is to be half filled with water, or in frosty weather with a mixture of equal parts of spirits and water, and then hung to the ceiling of a room with its bottom upward, so that the expansion of the air and contained fluid, by a slight increase of temperature, may cause the fluid to run out of the neck into a trough placed for that purpose, and having a small piece of loaf sugar at the other end, which retains a spring communicating with a bell.

Each of the rooms of the house being furnished with one of these alarms, the fluid thrown out by the increase of temperature in case of fire, would dissolve the sugar, and thus set the spring of the bell free, to give the alarm.

Observations.—This method of giving an alarm must be considered as rather fanciful; and would certainly require some attention to be paid to the fluid, to prevent the effects of evaporation, which might be partially obviated by having the neck drawn out to a capillary opening.

On the Uses to which the Leaves and Prunings of Vines may be applied in this Country. By Mr. James Hall.—*Phil. Mag. No.* 119.

The leaves of the vine, dried in the shade, make an excellent substitute for tea.

The prunings of the vine, of which many thousand cart-loads are annually thrown away, either fresh, or after being dried, may be mashed with water, and will make a good beer; from which a vinous spirit may, if required, be distilled; or if the fermentation be suffered to run on, they will, particularly the tendrils, form an uncommonly fine vinegar.

Observations.—To those who have brewing utensils, as is common in the country, and casks, this system may be recommended.

We believe that the shoots of that troublesome weed, couch-grass (triticum repens), may be advantageously used in making table beer, either by itself, or to form a weak wash, with which the malt or sugar may be subsequently treated.

On blasting Rocks, and Tamping. By Mr. John Taylor.—*Phil. Mag. No.* 118.

Several papers have lately appeared on the use of sand in blasting rocks, or other hard substances. (See Retrospect, vol. ii. p. 43.)—The process has been long known in Devonshire, but of late a new invention has been introduced, which possesses some further advantages: this invention consists in closing the hole upon the gunpowder with soft clay rammed down, which may be perforated for the fusee without danger.

This method may be applied to holes in all directions, and is peculiarly adapted for those rocks in which gunpowder is liable to be rapidly injured by water. Sand can only be used when the rock is bored perpendicularly; but the effect of gunpowder is much greater in those holes where the mouth is lower than the charge of powder, as has been frequently shewn by experiment. Therefore, in the artillery service, guns are in greater danger of bursting when fired with their muzzles depressed, than when

elevated. Holes for blasting mines are frequently so very wet as to preclude the use of sand, where other circumstances would allow it; but when clay is employed, the hole is instantly filled up with a water-tight substance, and an opening for the fusee may be made through it with an iron rod.

The use of clay is attended with the farther advantage of the substance being always at hand, where blasting is in use.

In very hard rock, or that which is much confined, as in the shafts and levels of mines, both sand and clay must yield to the usual method of tamping, yet clay will produce the fracture where sand would be blown out. So that in quarries and open works, where deep holes can be had, and the rock is seldom very hard, the use of sand and clay may be adopted, and will contribute greatly to ensure the safety of the workmen.

Mr. Farey mentions coal-ashes as having been employed as tamping. Indeed, most friable substances are proper; but the best are those that have also a certain degree of tenacity. The soft yellow copper ore, and common galena, are highly esteemed, and then broken tile; but the tamping usually employed is the soft schistose rock attendant on most metallic veins.

The use of copper nails to form the vent, has been often tried; but as they are not quite so convenient as iron, the miners will not continue the use of them.

Gillet Laumont lately proposed in France to increase the resistance of the tamping by loading the aperture of the hole: this has been long practised, on a more simple method than he proposes, by the Cornish miners; and it is certain some rocks cannot be blasted without it.

Pictet has conceived that a more effective explosion might be obtained by leaving a vacuity in the chamber. This is in direct opposition to the received opinions of persons conversant in these operations. In very wet ground, the gunpowder is used in cartridges of thin tin plate, and these cannot be made to fill the chamber completely; yet it is found to require a much greater quantity of powder than usual, so that the miners will use every other means in preference.

A person has lately proposed to employ powder of double or treble the strength of common cannon powder, and he thinks that holes of half the usual diameter might contain sufficient charges in equal lengths, which would of course be bored with much more ease and rapidity.

The annual expense of gunpowder for the mines in Cornwall and Devon amounts to more than £30,000.

Observations.—We do not hesitate to prefer the use of clay to sand, for tamping, as less liable to danger, and not requiring any tools but what are in common use.

On the best Means of preventing the fatal Consequences that so frequently occur from the Dresses of Females and Children taking fire.—Phil. Mag. No. 118.

On inquiring of several persons, how they would act, if the clothes of a female took fire while they were alone with her, none appeared prepared against such an event, and the rolling her in a carpet seemed to be the principal resource. It seemed never to have occurred that the apartment might not be furnished with a carpet, and that the removal of the chairs and tables would allow the flames to make a rapid progress, especially as they would be fanned by the operation itself.

The flames may, however, be instantly extinguished, by a person passing the hands under all the clothes, to the sufferer's shift, and thus raising them, and closing them together over the head, which will certainly extinguish the flames. If the female folds her arms before her, the business will be facilitated; and if alone, she may in most cases relieve herself by throwing her clothes over her head, and rolling or lying upon them.

Observations.—This method would certainly be very efficacious, but at the same time would run the hazard of suffocating the patient; it would therefore be better, in most instances of this accident, to be content with closing the clothes round the neck.

Processes employed in India for false Gilding, and White-washing. —Buchanan's Journey through the Mysore Country, &c.

The gilding in the palaces at Seringapatam is false, and prepared from lead only.

An oil, called gurna oil, is first made by boiling about 18lb. of linseed oil for two hours in a brass pot, to which about 6lb. of aloes being added, the boiling is continued for four hours more. Another pot being made hot, 12lb. of an elastic gum, called chunderasu (prepared from the milky juices of the ficus glomerata, ficus gonia, and several other trees), is melted in it. A cloth being tied over the mouth of a third pot, the linseed oil is first strained into it, and kept warm, while the elastic gum is gradually added; after which the oil is strained for use.

Three parts of English glue, dissolved in water, are added to 24 of very fine leaf lead, and the whole beat together for a day. The mass is then cut into cakes, and dried in the shade. These cakes are dissolved in water, and the metal spread thin with a hair brush upon paper, which after being dried is polished with a stone,

till it acquires the metallic lustre. The edges are then pasted down on a board, and rubbed with the palm of the hand previously smeared with the above gurna oil, and exposed to the sun. On the two following days the operation is repeated, when it acquires a brass yellow colour.

The paper thus gilded is cut into the shape of flowers, and pasted on the walls or columns. The interstices are filled up with oil-colours; the oil for which is composed of two parts of linseed oil, and one of the above-mentioned elastic gum.

At Seringapatam they cover the (chunam) stucco of their walls with a thin coat of (suday) fine clay mixed with size; then a coating of (balapum) pulverized potstone; and finish the wall with a coating of eight parts of very fine ground (abracum) mica, with one of pulverized potstone, and one of size. The wall thus treated shines like the scales of fishes, and has a splendid appearance when lighted up; but in the daytime, walls covered with potstone alone look better.

Observations.—The use of Dutch gilding, or leaf brass, supersedes in this country the former of these articles; but the latter might be very advantageously employed in the decoration of country cottages.

Mode of constructing the recoiling Escapement. By Mr. Robert King, *of Scarborough.—Rep. of Arts, No.* 71, *Second Series.*

The angle of the inclined plane, on which the teeth of the wheel acts in recoiling escapements, has not been agreed on by the artists employed in making clocks and time-pieces. The angle of sixty degrees has been generally used; but with recoiling pallets, acting on a tooth during the recoil, the complement of the angle will be the angle of the inclined plane, which being only thirty degrees, will not push back the maintaining power with equal ease during the action of the pendulum on the wheel, as when it is pushed forward for the maintaining of the motion; and consequently every vibration of the pendulum is checked, and not suffered to have its full swing, and yet gives no correction thereby towards the isochronism of the motion, or to the equalization of the times of the vibrations.

Mr. King thinks, that to give the pendulum the greatest freedom of swing with recoiling pallets, *the face of the pallets ought to be at the angle of forty-five degrees to the tangent of the acting tooth or point, in every part of its action*; or at least to that of the point where the action begins. This angle was adopted by Mr. Henry Hindley, of York, as may be seen by examining the escapements of clocks made by him.

The figure given by Mr. King to explain the method of drawing the plan of this escapement, which follows, represents an escape-wheel of thirty serrated teeth, with the pallets so placed as to have an interval between them equal to seven teeth and an half. A figure of this wheel being drawn, from its centre draw two lines upwards, each forty-five degrees from the vertical diameter, which will enclose between them $7\frac{1}{2}$ of the teeth; then from the points where these lines cut the circumference at the outer extremities of the teeth, draw two lines perpendicular to those first drawn, and mark their point of intersection, which is to be the centre of the verge.

The serrated teeth of the escape wheel are formed by lines drawn to the centre, and lines inclining to the right side from the top of one tooth to the bottom of that next adjoining; the face of the pallet at the right side of this wheel will be marked by a line drawn, at an angle of forty-five degrees, to the line last mentioned, to be drawn from the circumference of the wheel to the centre of the verge; the place of the extremity of this pallet will be shewn by the point of intersection of the line of its face with a line drawn from the centre of the escape wheel, through its circumference, at the distance of half a tooth from the line, at the same side first directed to be drawn from the same centre to the same circumference, at forty-five degrees from the vertical diameter. To form the pallet at the left side, mark on the radius, before drawn at that side, a space equal to half a tooth beyond the outer circumference; a line drawn at this point across the radius, so as to form an angle of forty-five degrees with it, will describe the face of the pallet, and its extremity will be determined by the outer circumference of the wheel, which it is to be drawn so near to as only just not to touch it.

By this arrangement, at the instant when the right parallel has got free from the tooth that has been raising it, the point of the left pallet will be brought within the circumference of the wheel, and meet the point of the tooth next behind it at that side, and recoil upon it until the force of the pendulum is lost, and the tooth acts on this pallet to impel it in the opposite direction.

In these pallets the line of impulse is equal in each, and the pendulum has the same power on the wheel in the recoil, as the wheel has on the pendulum by its forward action on the pallet; and the wheel acts with equal force on each pallet, as being at an equal distance from the verge; and the pressure of the wheel against the pallet being always equal, this escapement may be considered as a good one, only that the tooth acting on the left pallet approaches the centre of the verge, while that acting on the right pallet recedes from it, so that the power of the action of the wheel decreases while acting on one pallet, and increases while acting on the other. Yet on the whole these pallets are best for common purposes, only the vibration is great. This escape-

ment may be farther improved by taking away the recoil, when it becomes superior to Graham's.

Observations.—In describing the above method without a figure, the words of the original have necessarily suffered some alteration, but the sense has been carefully preserved. Perhaps it would facilitate the execution of the figure to any one wishing to draw it, to know that the face of the right pallet is vertical, and that of the left pallet horizontal, and that consequently their planes are at right angles to each other.

Mr. King says, that it was in consequence of a suggestion in the observations on Graham's dead-beat escapement (RETROSPECT, vol. ii. p. 427), that he was induced to publish an account of this method. In this instance, as well as in many others, we have the satisfaction of seeing the reward of our labours. We find also, that in Mr. Parke's notes to his Chemical Catechism, several occasions are stated, wherein our work has been found productive of great advantage.

A Description of a double-lever Press for various Uses, particularly applicable to the pressing Water out of Clothes, commonly done by Wringing. By Mr. J. J. HAWKINS.—*Rep. of Arts, No. 72, Second Series.*

IN Mr. Hawkins's press a piston, formed of two pieces of wood placed so that the grain of one crosses that of the other (from which a piston rod rises with a rack at each side, having serrated teeth pointing upwards), is pressed downwards into a cylindrical tub, perforated with several holes, by two levers, with catches formed at their sides to hold the racks: the pieces into which the levers are jointed, so as to allow of a vertical motion, have pivots proceeding from them upwards to an horizontal bar, in which the piston rod slides up and down, which retain the joints in their places, and at the same time allow the levers to be moved laterally so as to be detached from the racks, when it is desired to remove the articles from the press.

The frame of the press is merely a strongly-jointed square frame, with cross pieces placed horizontally beneath it to serve as feet to support it. Beneath the bottom of the tub a solid piece is placed so as to be level with the outer edges of the staves, to prevent the pressure from forcing out the bottom; and at the inside a wooden ring is fastened in the angle which the bottom makes with the sides.

The piston rod is kept vertical by a dove-tail sliding-piece that moves in a dove-tail groove in the upper part of the frame; a

notch at the bottom of the slides permits its being removed from the groove.

The piston rod and racks, and the jointed ends of the levers, are formed of cast iron; the handles of the levers, and all the rest of the press, are made of wood.

When this press is used for clothes, they are to be put into a bag, and placed in the tub after twisting the mouth of the bag together.

A tub of eight inches diameter, and eight inches deep, will hold six or eight shirts; if a larger size is required, it is best to increase the depth of the tub, as increasing the diameter would make much longer levers necessary. The height of the frame in Mr. Hawkins's model is thirty inches, and the length of the levers thirty inches; they operate on the racks at two inches distance from their centres of motion, so that their power multiplies the force used in moving them fifteen times.

This press can be procured at much less cost than a screw press; it can be worked in much less space; and the articles pressed in it can be taken out instantly, which requires a considerable time to do from a screw-press, as the screw must be turned backwards to its first position for this purpose.

Observations.—Pressing by two levers acting alternately on serrated racks is an old contrivance; prints of an apparatus of this kind, designed for eradicating trees, may be seen in some agricultural dictionaries printed many years ago. Similar presses have been described in many works that treat of mechanical subjects, and among others in Doctor Young's Philosophical Lectures. It is probable Mr. Hawkins was not aware of these circumstances when he published the principle of the press as his invention: the particular application of it to the purpose of washing clothes is, as far as we know, to be attributed to Mr. Hawkins. In comparing this press with the screw-press, it will be found, that though this may be best for small forces, the screw is much superior where great power is necessary; for from the extent of surface with which it may be made to press against its nut, it can be formed strong enough for any force without danger of breaking; whereas a very small comparative force would break off the teeth of the racks, or the catches of the levers, in the lever-press; and with levers of equal length, the screw-press would have a vastly superior force. Mr. Hawkins's press, as described, multiplies the force applied only fifteen times, but a screw with the same lever, and having even no more than one revolution of the thread to the inch, would multiply the force more than ninety times. The lever-press we, however, think to be very sufficient for pressing clothes, or for similar purposes; but in houses in the country, where there are cheese-presses, they may be made to perform such operations equally well.

On the distinctive Difference between his own and Curr's Patent for flat Ropes. By Mr. WILLIAM CHAPMAN.—*Rep. of Arts, No. 73, Second Series.*

MR. Chapman says, that Mr. Curr expressly states in his specification, that his method of making flat ropes is by laying two or more small *ropes* side by side, and securing them in that position by stitching, or any other mode; but his own flat bands or strand bolts are made of the primary strands used in making strand-laid rope, which is, indeed, one of the stages through which hemp passes when it is manufactured into rope, but by no means rope itself.

Flat bands have been already made of girth web made from untarred rope-yarn, or hempen yarn; and they might also be made of salvagee, i. e. yarn stretched at length and bound together; knittles, i. e. flat lines of three rope-yarns platted together; sennet, i. e. an uneven number of yarns so platted together as to resemble a double cylinder; or gaskets, i. e. sennet with an eye at one end, and tapering at the other. All these combinations were examined by Messrs. Chapman, and their relative strength decided by experiments.

The major part of inventions are only new combinations of old instruments, or materials; and trifling deviations only from an old practice to obtain the same end is piracy; but if the object be to obtain a more valuable end, or to shorten the process, and reduce the quantity of materials; in short, if any real improvement be produced, the invention has a patentable right.

Novelty and utility is also claimed by Messrs. Chapman in performing the operation of combining strands by a moveable machine, while they are equally stretched; as from the want of such a contrivance the flat ropes formerly made have been found to break their stitches when exposed to sudden jerks.

Observations.—We think Mr. Chapman has made out very fairly, that he neither unintentionally nor intentionally has infringed upon Mr. Curr's patent, as he uses the materials employed by Mr. Curr in an inferior degree of preparation.

Patents are granted for the benefit of the community at large, and for the particular advantage and encouragement of ingenious individuals; they are, however, restrictive instruments, and therefore the invention should be described with great perspicuity. The courts, indeed, have always construed them with much liberality, not suffering trifling evasions to set them aside.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, DURING THE MONTHS OF APRIL, MAY, AND JUNE, 1808.

Mr. WILLIS EARLE's *Patent for certain Improvements in the Tillage and Dressing of Land, and the Cultivation of Plants. Dated January* 1808.—*Repertory of Arts, &c. No.* 71, *Second Series.*

THE improvements laid claim to by the patentee are stated to consist—"1. In so managing the land in tillage, that in many cases, after producing a crop, it is or may be worked with great expedition, and sufficiently to be capable of receiving another crop by means only of such plough or ploughs, as, however otherwise constructed, have respectively two mould-boards, and throw the earth raised by them to each side of their furrow; or otherwise by such plough or ploughs assisted by one or more harrows and a roller, or either of them; or by means of other instruments having similar effects: such culture being attended with many important and peculiar advantages, especially in the disposition and cropping of land, and being also, in great part, applicable after a course of ordinary tillage.—2. In an expeditious and ultimately economical method of manuring and dressing land, peculiarly adapted to the before-mentioned system of cultivation; whereby the manuring or dressing is more suitably distributed, and rendered more effective than by the usual processes.—3. In certain convenient modes of combining and conveying manures or dressings to be laid on land, or incorporated with the soil thereof; and in the extension and improvement of various methods of cultivation already in practice.—4. In the combination of any of the before-mentioned improvements in the culture of the same piece of land."

Having in these terms described the principles of his patent, he next proceeds to point out how the operations are to be performed; he directs that parallel furrows should be drawn with a double mould-board plough from one end of the field to the other along the ridges or flat ground at such distances from each other, that one part of the soil may be stirred to a proper depth, and the remainder of the surface covered with such part of the earth as is thrown out of the furrows; dividing the land, as it were, into distinct parallel portions, of which every alternate one is in a state of cultivation, and the other alternate portions lying at rest, and covered over and raised with some of the earth thrown out of the

cultivated portions. It is said that if this operation be performed soon after the removal of the preceding crop, all weeds will be buried, and a new crop may immediately be sown either by drill or otherwise in the cultivated parallels. Various methods are then detailed for putting in the crop, and covering it in this furrow or cultivated parallel; but as these form no part of the principle of the patent, it is not necessary to describe the particulars.

When the crop is in growth, horse-hoeing is pointed out to be frequently requisite both for keeping the land clean, and in some cases when the second improvement is adopted, for carrying the same into effect, for it is held to be essential to the system proposed that not a weed remain to ripen its seed. In crops of corn, rows are recommended from eighteen inches to two feet apart, as the most convenient for the greater part of the operations, and yet sufficiently near to afford a full crop; and in adopting this system of husbandry the agriculturist is cautioned not to misapply it by attempting land too foul with weeds, or too stubborn from the tenacity of its nature. It is stated that in almost every instance where it is immediately applicable two ploughings will be found to be sufficient.

As the crop proceeds in growth the soil which was left ridged up on the uncultivated parallels is to be turned towards the roots of the plants by means of a single mould-board plough, which will at the same time make and leave a furrow on each of the rows of the growing vegetable.

Into the channel thus made is to be conveyed manure, either itself in a liquid state, or suspended in a liquid,—which forms the second division of the patent. To accomplish this, tanks or reservoirs are directed to be made in the highest part of every field, which are to be filled with liquid impregnated with manure, or in which manure reduced as nearly as possible to a pulverized state is to be mixed up; and this is to be conveyed to the crop by a main drain leading from the reservoir to the channels on each of the rows of corn, which have been before described.

The third part consists merely in predisposing manure or compost in such a manner as to be most easily soluble in water, or in rendering it so light and friable, as, when agitated in a running stream of liquid, it may partly or altogether remain suspended therein.

The fourth part has been already noticed to consist in the combination of any of the former parts.

Several pages are subjoined of illustration and remark to shew the practicability and advantage of the system, and an experiment by himself is mentioned, which indicates an increase of produce beyond what is obtained in the usual methods of cultivation; and the primary advantage is stated to consist in abrogating the necessity of fallows. The terms on which the patentee will *permit* the use of his improvements, are two shillings and sixpence an

acre, for the first part of the specification, and the same sum per acre for the other improvements, to be paid for every year the improvements are adopted.

Observations.—A patent for the cultivation of the soil is in itself so *novel,* as to demand attention. The system introduced by this patentee is to divide the land as nearly as possible into two equal portions by alternate parallels, so that one of them may be cultivated every second year, and the other be at rest, or, according to the common term, remain fallow. This system certainly admits of a most complete destruction of weeds, and the method of planting the crops in furrows below the general level of the soil seems to be borrowed from the practice of gardeners, the most intelligent of whom have long adopted this plan in the cultivation of culinary vegetables with the completest success. The method of conveying manure by solution or suspension in water immediately to the roots of the plants is a plan very economical, but we fear it is practicable in very few instances; nevertheless the suggestion may lead to improvements more extensively useful. It has been long matter of serious regret to intelligent agriculturists that the drainings of farm-yards and dung-hills should be overlooked, and lost to the soil, and many of them have had recourse to contrivances for their preservation and use. However well adapted Mr. Earle's system may be to well-cultivated level soils, it can never admit of general introduction.—How far an exclusive patent for the cultivation of the soil in a particular way can be supported, is a question of law and not of criticism.

Mr. John Williams's *Patent for a Method of preserving the Equilibrium, and preventing all Kinds of Carriages from overturning. Dated Dec.* 1807.—*Rep. of Arts, No.* 71, *New Series.*

Mr. Williams describes his invention in the following words: "I do substitute in the place of an inflexible axis, a pair of levers proceeding horizontally on each side in opposite directions from the same part of the perch, or middle bar, or framing made use of to connect the wheels together, and at right angles to the line of traction: I join the levers to the perch by a hinge, so that each of the levers may be allowed to move in a vertical circle up or down, but not at all sideways, and upon the extremities of the said levers I put my wheels." He then mentions that the body of the carriage is to be supported by springs on the levers alone in some constructions, and in others to be fastened to the frame-work, and have springs proceeding downwards to the levers, and in some cases to be also sustained by springs bearing on the perch before and behind.

The advantage of this construction he states to be, "that whenever an obstacle or cavity shall present itself, the wheel shall pass over or be depressed into it, without producing so great a disturbance of the equilibrium, or so much endangering oversetting the carriage, as would happen without the use of his invention.

Observations.—Wheels placed at the end of levers, capable of a vertical motion round the perch, at right angles to the line of draft, as described in the specification of the above patent, would vary continually from the perpendicular position, which is most favourable to the draft, to the wheel, and to the road; sometimes they would be more near to one another at top than at the road, and at other times the reverse, according to the weight in the carriage, or the force of a jolt.

Of the three methods mentioned for placing the springs, the second alone would be of any use, the first would not prevent the levers from coming in contact with the frame-work of the carriage, which would hinder the springs from acting; and the third method would be entirely superfluous, when the second was used; as from the words of the specification it must be.

The design of the invention (pointed out in the advantages of it stated by the patentee) seems to be the same as that effected by Mr. Elliot in his patent carriages without perches, noticed in our last number, but does not deserve to be compared with them on account of its defects. It appears to us to be at least as much worse than the common method, as Mr. Elliot's method is better.

Mr. John Wilkinson's *Patent for a Method of making Pig or Cast Metal from the Ore, which, when manufactured into Bar Iron, will be equal to any imported from Russia or Sweden. Dated Jan.* 1808—*Rep. of Arts, No.* 71, *New Series.*

Mr. Wilkinson specifies his invention, for making iron equal to Swedish or Russian bar iron, to consist in making use of manganese, or of ores containing manganese, in addition to iron-stone and other materials, now used in making iron, in certain proportions to be varied by the nature of such iron-stone, and other materials.

Observations.—The discovery of the good effects of manganese in the manufacture of steel, was made long before the date of this patent. In the Annales de Chimie, tome xxxvi. p. 61, M. Gazeran has given a paper on the subject, in which he states that in the German founderies, particularly about Nassau-Siegen, they used

the black ore of manganese with the iron ore in making steel; he advises that from 4 to 5 per cent. of manganese should be mixed with the ores that do not contain it naturally, and states that the best German steel contains 2.16 per cent. of manganese and 1 of carbone.

In most of the periodical works published in London that treat on such subjects, the above facts have been given: Mr. Wilkinson cannot therefore have the honour of being the first discoverer of the advantage of manganese used in this way; but for the particular application of manganese to the manufacture of bar iron from crude iron, we at least do not know any one prior to him. The specification contains no directions whatsoever as to the proportions of the materials to be used; but states that they must be entirely governed by the experience of the peculiar nature and quality of the ores used, of which scarcely any two are alike; and that they must be varied till the result is such as is desired.

Mr. Edward Thomason's *Patent for an improved Mode of making Hearth-brushes. Dated Oct.* 1803.—*Rep. of Arts, No. 72, New Series.*

The object of Mr. Thomason's invention is to construct the hearth-brush so that the handle may be much shortened, at the same time that the bristles are hid from sight, and that the same motion which brings the bristles into view again shall lengthen the handle. This is effected by having the handle formed of two tubes, one of which slides within the other, and has its lower end enlarged so as to admit the brush within it. In the middle of the inside tube is placed a pinion, at the opposite sides of which two racks pass, one of which is connected with the upper part of the outside tube, and the other with the brush: the consequence of this arrangement is, that when the enlarged part of the inside tube is held in one hand, and the outside tube drawn from it by the other hand, the upper rack forcing the pinion round makes the lower rack descend at the opposite side of it, and forces the brush attached to it to come out from its case; and the contrary movement forces it to ascend, and become covered. The patentee mentions another method of effecting the same purpose, in which he has two rollers placed in the inside tube, round which an endless strap passes; to one side of which a sliding piece is fastened that communicates with the upper part of the outside tube, and to the other side another sliding piece is fixed that at its lower extremity is joined to the brush; this arrangement of parts has the same effect in protruding and retracting the brush as the racks and pinion before described.

No particular substances are directed for the fabrication of these sliding handles, but it is probable brass will be preferred for them.

Observations.—The principal use in forming the brush so that it may be protruded from and retracted into a case, is to prevent the paper or wall of the apartment, or the furniture, from being soiled by it when it is not in use.

The great complication of late introduced in many of the commonest utensils may be objected to. Corkscrews are now made with an intricacy of parts at least as great as that which Hogarth held up to ridicule in one of his most noted pictures; we have patent sliding telescopes, pocket spring toasting-forks; and hearth-brushes, according to this patent, may be added as not the least instance of the same kind. That all these utensils are more complicated and costly than their advantages can compensate for, is certainly very true; but surely the gratification procured by the convenience they produce, or the pleasure of exhibiting them, is a very innocent one, and as it tends to encourage ingenuity and the arts is deserving of praise instead of censure. Perhaps it may not be altogether just to class these brushes merely in the list of ingenious toys, as they have the use above pointed out; some may think this of no great consequence: fortunately all those may please themselves at a cheap rate; but those who value ingenious and handsome contrivances to promote cleanliness will find hearth-brushes on this principle worthy their attention. Hearth-brushes of a similar kind, that cover the brush equally well, have been made without any racks and pinions, and been in public use before the date of this patent.

Mr. Samuel Salter's *Patent for an Apparatus for the Purpose of drying Malt, Hops, or any Kind of Grain. Dated Dec.* 1807. —*Rep. of Arts, No.* 72, *New Series.*

The specification of this patent relates solely to the construction of the fireplace of a kiln, in which there is nothing peculiar, but two pieces of iron eighteen inches long, two thick, and six deep, directed to be placed so that one shall project from each side of the fireplace into the fire. The door of the fireplace and of the ash-pit are ordered to be furnished with registers, so as to regulate the admission of air to the fire from the latter, and to the malt from the first; but no way is mentioned in which the air is to find its way to the malt, or by which the smoke of the fire is to pass off without mixing with the air. The bars of the fireplace are to be half an inch asunder, and the ash-hole is to be eighteen inches long, twelve wide, and twelve deep; which are the only

dimensions of parts of the apparatus specified. It is mentioned at the end that the top of each of the sides of the fireplace forms the base of an arch of cast iron or other materials, but no information is given whether this arch is to be perforated with holes to admit the hot air to the articles to be dried.

Observations.—It is difficult to conceive what could induce the patentee to incur the expense of a patent, by which he has not secured himself the exclusive use of any thing, but of two pieces of metal or other substances about eighteen inches long, fixed so as to project six inches into the fire; the advantage of which in the purposes which he states, of throwing more heat into the kiln, and saving the sides of the fireplace from being destroyed by the fire, are very doubtful.

This patent is the most remarkable for its inanity and inutility, of any we have ever witnessed. It certainly affords nothing that can ever be of the smallest advantage to the public; and the only use we can conceive it could be to its proprietor is to induce people to suppose, from his having obtained a patent, that he has some knowledge of an advantageous mode of drying malt or of building kilns, which he either does not possess, or at least which, by his not mentioning it in the specification, cannot be secured by his patent, or be considered at all as a patent method.

Mr. William Weller's *Patent Copper-plates for printing Policies, to secure Persons from Loss of Property of certain Descriptions. Dated June* 1800.—*Rep. of Arts, No.* 72, *Second Series.*

These are folio copper-plates serving to print the usual formalities in policies, to insure persons against burglaries, highway robbery, horse-stealing, cattle and sheep stealing, private stealing, &c. on certain conditions, offering rewards to the apprehenders of the criminals, and gratuities to the relations of those killed in defending the property that is insured.

Observations.—We cannot but consider this as a most foolish attempt to give some colour to the boundless cupidity of a speculator.

Mr. George Savage's *Patent for regulating or equalizing the Force of the main Spring in Watches, or other Time-keepers. Dated Jan.* 1808.—*Rep. of Arts, No.* 71, *Second Series.*

This regulation of the action of the main spring consists in introducing a minor spring to be wound up by it at certain periods.

Pins placed in the hour or centre wheel force up at certain periods, according to the number of the pins, a lever connected with a detent, or small pallet, and thereby unlock a quarter piece which covers the minor spring. The lever is again brought to its proper place by the pressure of a spring. By this means the main spring winds up the minor spring situated under the quarter piece, and moving upon a bridge.

Observations.—This pretended invention is nothing but the well-known contrivance of the remontoir, said by Berthoud to have been known as early as 1600. At all events, it was described by Huyghens, and after having been adopted by Harrison, and some other watch-makers, was laid aside as totally useless.

The Rev. Mr. Henry Charles Sebastian Newman's *Patent for a Cattle-mill to express the Juice of the Sugar-cane. Dated March* 1807.—*Rep. of Arts, No.* 71, *Second Series.*

The spindle of the middle roller in a sugar-mill is to be perforated with a socket, and carry also a large cog-wheel. The socket is furnished with a gudgeon turning on a pivot and steel plate at the bottom of it. A horizontal shaft passes through an eye or ring in the gudgeon, and having on one end a lantern-wheel, acting on the cog-wheel of the spindle, and on the other which is supported by a circular ring or wall a heavy wheel serving to increase the friction of the shaft on the wall. This horizontal shaft turns also in a collar affixed to a pole, on each side of which one or more horses are harnessed.

Observations.—As the weight of the wheel at the end of the horizontal shaft must incommode the cattle, its effect may be attained in a better manner, by using another lantern-wheel, turning upon cogs fixed vertically in the circumference of the circular ring or wall.

It is far better, and more usual, to accelerate the motion of the middle roller by fixing a pinion on its spindle, which may be drove round by a large horizontal cog-wheel that is turned by shafts to which cattle are harnessed.

Mr. Robert Barlow's *Patent for certain Oriental aromatic chemical Compositions, which he denominates ebenbosamic and ebengavicbosamic Compositions. Dated June* 1807.—*Repertory of Arts, No. 72, Second Series.*

Insulate any aromatic herbs in alkohol for about a week, and then distil off the spirit, and dissolve therein any aromatic gum, and afterwards add rose-wood, rose-leaves, and orrice-root, till it becomes of the consistence of paste.

To one lb. of this paste add 3 drachms of otto of roses, 4 of oil of cloves, 4 of musk, 2 of frankincense, 2 of myrrh, 1 oz. of oil of sweet nuts, and such vegetable colours as fancy shall dictate; and lastly, form the composition into any required shape, by moulds, when it will resemble different kinds of stones, and possess a delectable fragrance.

Observations.—We must leave the ladies to decide on the merits of these scented ornaments, as they must be more competent to determine on such subjects than we.

We do not profess to have any knowledge of the language which Mr. Barlow employs to denominate his perfumed ornaments; but suspect the terms ebenbosamic and ebengavicbosamic, to be some bastard offspring of the French chemical nomenclature.

Mr. Hawkes's *Patent for a Method of making and keeping in Repair Cast-iron Wheels, for Coal-waggons and other Carriages. Dated Nov.* 1807.—*Repertory of Arts, No. 72, New Series.*

The wheels for coal-waggons and other carriages that run on rail-roads, are made of cast-iron; it is for the improvement of such wheels that Mr. Hawkes's method of forming wheels is principally intended; which consists simply in casting wheels in two or more parts; which are to be joined together afterwards by screws, rivets, mortises, dovetails, keys, or other methods, as is frequently done in machinery used for mills and other purposes.

The wheel, of which a drawing accompanies the specification, and which is intended for a coal-waggon, is represented as cast in three separate parts, united afterwards by screws: that is to say, all the spokes are cast together with a circular piece in the centre, that has a perforation to receive the nave; which is cast separate, so as to fit it; and the rim is cast by itself, and united to the rest by screws at the ends of the spokes.

Observations.—When wheels are cast all in one piece, they are partially weakened by the irregular contracting of the spokes and rims, in cooling, and are consequently liable to be broken from

trifling shocks or jerks; and when any part of them is broken the whole is useless. Mr. Hawkes's method removes these defects; for, each part of the wheel, cast separate, contracts equally, and if the rim, or the spokes, be broken, they may be replaced, and the other parts continue still in use. The wheels will be also stronger for a given quantity of metal, and the expense of them for any considerable length of time will be much less. For wheels cast in one piece, the softest metal must be chosen, to prevent the danger of their breaking from unequal contraction in cooling; but for those, whose parts are cast separately, such metal may be chosen as is best suited to their durability, and thus will this quality be united in them to strength and economy.

Mr. William Newberry's *Patent for Machinery for sawing Wood, splitting Skins, &c. Dated Jan.* 1808.—*Repertory of Arts, No.* 73, *New Series.*

Mr. Newberry's engine is formed by a long and very flexible blade, of a similar nature to a clock spring, which passes over two rollers, of considerable diameter, placed in the same plane, and whose two extremities are united so as to form a band round the rollers.

When this blade is intended to act as a saw, one of its edges is cut into teeth of the usual shape, and the substance to be sawed is placed on a stage, through which the blade passes, and is pressed against the blade with the necessary force, and in the direction proper to produce the shape required for it: pieces called guides are placed at each side of the stage, to direct the blade, and the stage is so formed that it may be fixed in any angle with the horizon desired; in order to produce cuts in regular bevels, the rollers for the saw-blade are placed vertically, and are made large, that the bending of the blade, and its consequent resistance, may be the less.

When the blade is intended to act as a knife (as when it is used for splitting and paring skins), the rollers are placed horizontally, and whetstones are fixed at both sides of the blade, to give it a proper keenness. The rollers are formed like wheels, are made of cast-iron, and have an iron flanch cast, or screwed, at right angles to their faces, to prevent the blade from running off backwards; wedges are placed at the axle of one of the rollers, in such a manner, that, by driving them, it will be forced farther from the other roller, and the blade thereby obtain the necessary tension. By turning one of these rollers, which may be done in various ways, the proper motion is given to the blade.

Descriptions of two frames, for directing the shape of materials to be sawed, are contained in the specification; they are both to be attached to the stage: one of them is for cutting circles of all

sizes, and has a rod attached by two or more diagonal pieces to the timber at one end; while its other extremity is fastened to a central piece, which can be placed at any distance from the work, according to the size of the circle required, by moving it along a slide placed for that purpose, in any part of which it may be fixed, by turning a screw. The rod passes through a part of this moveable centre, and may be fixed to it, at the spot required, by another screw; this part turns round, so as to allow the rod to turn with it freely.

The other frame is for cutting pieces of irregular shapes, according to a pattern; a slider, carrying two or more small rollers, parallel to the saw, is for this purpose placed at one side of it; this slider moves to or from the saw at pleasure, and is fixed by a screw at any required distance; another roller is placed at the other side of the saw, and made to press against the work by a spring; the pattern is fastened to the side of the work next the fixed rollers, and moving it in or out laterally according to its protuberances, as it is pressed forwards, gives it a shape similar to its own.

Observations.—Mr. Newberry's sawing engine has the advantage of others already contrived in the facility which it affords of forming work of various shapes, by patterns or moulds, in any required bevel. For sawing heavy work of this kind, it is probable that rollers, placed behind the saw, at each side of the work, and as close to it as possible, would be useful to support the saw in its place against the work as it might be pressed forwards.

Mr. Bryan Donkin's *Patent for producing a rotary Motion. Dated August* 1803.—*Repertory of Arts, No.* 73, *Second Series.*

In this method of producing a rotary motion, the steam from a boiler is to be introduced under buckets inverted in a convenient fluid, which will, if the fluid be of such a temperature as not to condense the steam, render the bucket, into which the steam is introduced, buoyant. The buckets are to be arranged round the circumference of a wheel, or to a circulating chain, or any other mode, so that they may successively arrive at the place where they are to receive the steam, and ascend in their turns; by which means a rotary motion will be produced.

Observations.—This invention is simpler, and the apparatus will be far less costly than common steam-engines; but its power will also be much weaker, and it will consume far more fuel, in proportion to the effect produced. It may, however, be very

useful in many cases, as in turning lathes, where only a small force is required, provided its regularity can be ensured.

It does not appear to us that any other fluid than water can be employed to float the buckets; and this water need not be heated, as the steam itself will raise the temperature of it as high as is necessary, and as quickly as could be done by any other mode.

Mr. Francis Plowden's *Patent for aphthartic Viands. Dated June* 1807.—*Repertory of Arts, No. 73, New Series.*

This invention is for preserving butcher's meat, animal and other comestible substances, for an extraordinary length of time, in a sweet, palatable, and nutritious state, fit for consumption both at sea and on land, without acid, salt, or drying.

Although atmospheric air is not the sole efficient cause of putrefaction, yet the contact of it accelerates the process of destruction; and therefore putrefaction must be hindered by enveloping the substances in an air-proof medium, which, however, ought not to impart any noxious quality.

The substance to be preserved is to be wiped dry, and, being cold, and free from any insect, worm, or part already in a state of putrefaction, is to be placed in wooden vessels, and to have the concentrated essence of some other meat poured on it, so as to fill up every vacancy.

Observations.—This process differs from that of potting, described in every treatise of cookery, and constantly practised for ages, in only two particulars. First, the use of wooden vessels, which is certainly no improvement; and, secondly, instead of clarified butter, Mr. P. uses portable soup to fill up the interstices. Although this envelope may, when the vessel is opened, be itself used to make broth, yet the enormous expense in the first instance, and the equally large proportion of broth that may be made from the enveloping extract, so far exceeding what is used in English housekeeping, will certainly render this patent of little use to its proprietor.

We are surprised that the speculators in patents have passed over the very obvious mode of preserving animal substances by barely pressing out their juices. The Chinese are said to prepare their pork for travelling in that manner, and the preparation of brawn is somewhat similar. If meat were subjected to the action of a screw-press; or, where that machine was wanting, or a greater pressure required, if it were placed between iron plates, in a frame of wood, and the plates brought closer, by wedges, on the principle of an oil-mill, there is no doubt but that the meat might be brought to a state in which it may be preserved for a great

length of time. And experiment would soon determine the necessary pressure for preserving it for any limited time, without much injury to its being dressed as usual.

Mr. Samuel Williams's *Patent for Machinery for preparing and spinning Wool, and other filamentous Substances. Dated April* 1807.—*Repertory of Arts, No.* 73, *Second Series.*

The first branch of this invention is founded on the principle of the different curves described by cylinders or cones, turning on their axes or planes, or in the cavity of hollow cylinders; the surfaces of these bodies being covered with wires, will divide the wool or other filamentous substance, every time the contact takes place, and thus open it, and distribute it over the whole surface.

When a small cylinder rolls on a plane, a point on a larger concentric one will form a loop, by moving backwards for some time, while the common centre is moving forward. And this may be more usefully applied to practice, by causing this motion of the small roll to take place in a hollow cylinder.

It may also be combined with another new and useful property, and the feeding and issue of the staple regulated by forming the hollow cylinder of an endless chain of staves. These wired staves pass over two wheels, and afterwards their ends enter a circular groove in each cheek of the frame, which causes them to form a hollow cylinder. In this cylinder, another smaller one, also furnished with wires, gyrates. The staves are then drawn over two other wheels, that the wool may be combed off; and then they pass to the two first wheels, that they may be again charged with wool.

Another principle for carding, is a series of revolving cylinders, whose touching surfaces move the same way, but each has a swifter motion than its predecessor, by which the wool is opened, and may have its surface so enlarged, that no two hairs shall touch one another. By adding another series of cylinders, with motions progressively slower, the same wool may be again collected into a small compass, for forming a riband or large thread. In this system, cards with perpendicular wires are preferable, but common cards may be placed crosswise on the cylinders, so that the wires may be upright in respect to their line of motion. By these cylinders the wool is, in effect, carded backwards and forwards, as in hand-carding; after which, cylinders with hooked cards are employed to receive the wool, and deliver it as usual.

Upright card wires are best formed by turning up in the middle the two legs of a right angle, formed of wire. As they must be placed in the cylinders without any interval, the leathers entirely filled with these wires, are placed rather obliquely across the cylinders, and at one or both ends are fastened to a metallic

tightener, turning on the axis of the cylinder; by which they may be stretched, and their wires acquire the necessary stability, as well as be brought closer. The principle of spinning filamentous substances is founded on giving the thread a twisting motion, not only at either end, but also at some intermediate point; which is in fact to twist one part, and to untwist the other. Now the untwisted part is weakened or rendered extensible, while the part that is twisted holds stronger together. Hence if while a thread is passing from cylinders having a given motion to others moving faster, and is almost untwisted as it goes, it will give way in the untwisted part, and lengthen in proportion to the drawing tendency.

To perform this untwisting operation, any method may be employed by which the thread can be turned round its axis without obstructing its longitudinal motion. Of these several examples are given, for which we must refer to the original.

The drawing of the thread may be performed by the sole friction of the threads round the drawing cylinders, without pressure; the cylinders being placed at a small distance from each other, so as to bend the thread as much as possible, or in many other manners. Drawing systems may also follow each other to any number, and in any proportion of velocity so as to draw down at one passage the largest thread to the smallest size: and instead of always using spindles, the thread may be reeled as it is spun.

To communicate motion in an uniform manner from one wheel or machine to another; a chain formed of articulations, in the form of a chevron, is made to move wheels whose teeth are of the same form, so that before one link or tooth has ceased to act, another is already acting. This chain may be made solid, with chevrons in relief only.

To avoid the use of cords or strings in the machinery, wheels are employed, whose teeth are essentially oblique, or of a screw form, either made like chevrons, or single; in both cases the extent of the obliquity must be as great, or greater, than the distance between two contiguous teeth. If it be intended to save all the friction, the wheels must lie in the same plane. These teeth, by wear, assume an epicycloidal form, and when their form is become perfect, they cease to wear any more. The same principle applies to bevel wheels, save only that in cylindric wheels, the teeth are threads of a screw, and in bevel wheels they are solid helica, increasing in dimensions and distance as they fold obliquely round the surface of a cone.

The wool may be taken off cylindrical cards, for the purpose of spinning, by using other cards placed obliquely; and then using a circular comb, formed like the crown wheel of a watch, to strip the oblique card of its contents.

A series of narrow cards, with diagonal teeth, may also be

put on a cylinder, or cone, so as to work against the cylinder of a common card; and another series of narrow cards, placed opposite to these, to sweep the intervals left by the former. And to these diagonal cards circular combs may be applied, and under or near them, an equal number of either spinners, or bobbins, or both.

Another new method of dividing the sheet of filament into ribands, is by using a series of diverging cones, turning on their own axes properly inclined, and touching the cylinder.

Another method for opening and carding filamentous substances, is by placing the hooks in circular rows, on two cylinders, and between each pair of rows passing a portion of an endless line, which pushes off the filament on one side, and the whole series of lines serve, on the upper surface, at the same time as a feeding cloth. The same system may also be applied to the same purpose without lines, and by suitable metallic rings hung round a card cylinder, whose diameter is smaller than that of the rings, whence, as the cylinder revolves, the rings push off the filament. The rings may, if necessary, be weighed down by a cylindrical weight.

Several practical methods of placing these cards, and circular combs, are shewn, but they are too complicated to be described without figures.

To prevent an inequality of thickness in the sheet of feeding, by the same line in the riband of filament being always placed on the same circle of teeth in the card, a backward and forward motion may be given to the feeding cylinders, but it is necessary that this shake be nearly parallel to the card.

A throwing feeder may also be adopted, by enclosing the riband of filament in a hollow box, out of which the filament may be drawn as it turns round, and delivered to any number of combs or cards placed in a circle round it.

Long filaments, as flax, may be laid on an endless riband passing over two rollers; which riband is afterwards drawn through a short hollow cylinder, the inner circumference of which is equal to the width of the riband: by which means the filament will be rolled up on entering the cylinder. In this mechanical distaff, points or hooks may be applied, going through the riband.

For pressing filaments, whether for feeding or drawing, the surfaces of the cylinders may be cut into a very fine screw of many threads, both of the same kind, whether right or left handed. Hence, as these screws should touch only by the surfaces of their threads, there is no danger of breaking any one hair, although it should be between two pair of cylinders moving with unequal velocity, as it cannot be held by both but for an imperceptible moment.

A fasces of filaments may also be formed by placing them upon a system of rules with pins, and then communicating a different motion to the several rules, so as to alter their position.

This system becomes of more general use by the adoption of circular plates instead of bars; and to give them unequal motions these plates may be placed on hollow axes or cannons, one turning in the other, and furnished at the opposite ends with wheels of proper diameters to occasion these differences.

In order to take off the ribands formed on these circular plates, without danger of conglomerating the whole, conical combs may be used to cause them to diverge wider. It seems best to throw the filament on these plates in a diagonal or heliacal direction.

Many other forms of this system may be used, as the plates may be made less and less, so as to form a kind of cone; the points may also be placed in the same plane or parallel to the axis of their motion, or in a divergent or convergent direction.

Another means of separating the ribands formed by this system of points, consists in using plates which have not only a different diameter, but also a different centre. This eccentricity is producible by inserting lunular prisms, to fill up the difference of the diameter of any of the hollow axes, and that immediately above it.

Round a circular comb, any number of other combs may be placed, converging to the circumference of the circle, having a motion round their axes, and these combs may be of various forms, and have sometimes other combs placed obliquely in an opposite position. And this system may have any proper dimension, according as it is intended to open large quantities of filament, or to produce small ribands.

To take the filament off a throwing feeder, a conical comb, with its teeth converging towards the centre, may be used; and this comb may have a hollow axis, through which the filament, as it is taken off the feeder and twisted into thread, may be drawn away, and wound on a roller: or, in lieu of a perforated axis, a ring may be fixed over the conical comb through which the nascent thread may pass to the bobbin or reel. Other modes are also mentioned.

This new system of twisting the thread, permits the spinning of cords with any number of strands, and with any material, by using a sufficient number of feeding systems, combs, and rings; observing to make the common axis move contrary to the partial axes of the several systems.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

No. XV.] *July, August, September.* [1808.

AGRICULTURE.

An Essay on waste Lands, by JOHN BILLINGSLEY, *Esq. of Ashwick Grove, Somerset.—Bath Society's Papers, Vol. II.*

THE Bath Society voted their second *Bedfordean* medal to Mr. Billingsley for this production, which occupies the first place in their biennial volume of Letters and Papers. The writer remarks, that since the advancement and improvement of rural economy constitute a favourite object with the most exalted characters in the state, facilitating the division and improvement of waste lands and commons is an object anxiously to be wished for both as a means of promoting general prosperity, and as a measure calculated to increase the growth of grain, and thereby prevent a recurrence of scarcity; but that this system of improvement, so consonant to the principles of sound policy, has so many adversaries to encounter, that no sanguine hopes can be entertained of parliamentary assistance. For this reason he thinks we must look to agricultural societies for support, approbation, and encouragement; and he avails himself of the occasion to pay a well-merited compliment to the Society of which he is a member.

The objections which are generally urged against such improvements he ranges under four heads:—1. the heavy charges and other difficulties attending the dividing, allotting, inclosing, cultivating, and manuring, together with the necessary buildings; an expense altogether so great that the increased value of the land will be insufficient to repay it:—2. the prevailing opinion, supported, it is said, by dearly-bought experience, that such new inclosures, though productive for a few years, will soon return to their original sterility:—3. that *up-land* commons are a nursery

for rearing young cattle, and for depasturing large flocks of sheep without much expense; and that consequently they ought to remain in their commonable state:—4. that the inclosing of wastes has a tendency to depopulate the country, and to deprive the cottager of those privileges and advantages which are his birthright, and without which he cannot comfortably exist.

As the Essay itself is intended as a refutation of the *two first* of these objections, the author postpones the consideration of them: with respect to the *third*, he observes, that all who have been in the habit of depasturing their cattle or sheep on commons must have discovered that the ground is generally so overstocked, that animals of every description are stunted in their growth, and seldom come to any considerable size or value. The fears expressed in the *fourth* objection do not appear to him to be justified by experience; but as it has the appearance of much political sagacity, and implies such humane concern for the poor, it merits consideration; but he cannot admit that the resident inhabitants of any district should be lessened in number, or the poor injured, by a measuse which secures advantageous employment to the labourer, and enables the farmer to pay him better wages than before; for in every instance of inclosure which has fallen within his notice the cottager has gradually risen from sloth and poverty to active labour and comfortable subsistence; his dwelling has exchanged disease, and wickedness, and filth, for cleanliness and comfort; and his children, who were often without employment, and addicted to stealing and pilfering, have been furnished with an opportunity of contracting habits of industry, and have contributed by their earnings no small sum towards the exigencies of the family.

The writer of this Essay, presuming that the object which the Society had in view by offering their medal as a premium on this occasion, was to excite proprietors and occupiers of land to improve the various wastes which still remain in the western district, considered it the duty of those, whose practical knowledge enabled them to state with precision the profit and loss of such speculations, to furnish the public with the result of their experience; and as he had been engaged for more than thirty years in the improvement of waste lands, to the extent of several thousand acres, and in a climate so unfavourable to corn husbandry, as to render his first attempts objects of ridicule to his neighbours, and of concern and alarm to his friends, who, while they applauded his courage, predicted his ruin; and as his attempts had been successful to his utmost hopes, he details the result of his experience in preference to opinions yet untried; and, endeavouring to avoid all exaggerated statements, feels himself fully justified in the estimates which he gives: and it appears to him, that, under a judicious and prudent system of management, there will be found as great a profit attached to the employment of capital in the improvement of waste lands, as in any other mode, exclusive of the

satisfaction of seeing a barren waste converted into fertile inclosures, and healthy employment provided for families on districts where scarcely an inhabitant could be met with.

In treating on his subject Mr. Billingsley adopts a DIVISION into *five* parts:—1. Dividing and inclosing;—2. Farm buildings;—3. Cultivating and manuring;—4. Cropping and harvesting;—5. Succeeding management.

INCLOSING AND DIVIDING. By *inclosing* is meant the outside bounds of any new inclosure; and by *dividing*, raising the interior fences. Proceeding to consider the kind of fence, the method of making it, and the expense, he remarks, that if the land to be inclosed abound with stones, and these lie flat and thin in their beds, it may be advisable to give the preference to a stone fence in the first instance; but that this should not be relied on as permanent, because walls form a poor shelter for cattle from the driving storm, and give to the farm a very naked appearance, besides being liable to much injury from frost. Three kinds of stone fences are noticed;—mortar walls—part mortar, or list walls—and dry walls: of these the first are truly said to be the best, though few persons are willing to incur the expense of them; but the second kind will stand many years, if they are built with care: the dry wall is only proper for a temporary fence for the purpose of raising quick, which will, under its shelter, in a few years become a complete fence, and a permanent division of property, pleasing to the eye, and improving by time. It is stated, that a white-thorn hedge, raised under the protection of a wall, be the climate ever so cold, or the winds ever so tempestuous, will be rapid in its growth, and its sides soon become close and impenetrable, when the hedge may be taken away. If mortar or list walls be preferred, it is recommended to make them five feet and a half high, and two feet and a half wide at the bottom, tapering to fifteen inches on the top, on which should be put a covering of turf or scrapings of a road in the form of an arch, which will keep out the wet, and render the wall more durable: but five and a half, including the coping, is given as sufficient for a dry wall, built for the purpose of raising a quick. The quick should be planted on the contrary side to the prevailing winds, with the roots at a little distance from, but the top resting against the wall, and this close attachment will in some measure supersede the necessity of internal fences; for if the inside of the bank be made sloping, and a good ditch be cut, neither cattle nor sheep can do much injury. Where stones cannot be obtained, recourse may be had to earth-banks, with ditches not less than five feet wide at top, and two feet deep, the contents of which will be more than sufficient to form the bank: the quick should be planted in the centre, and the earth of the inside of the bank worked into a slope, that the mould may be drawn down to the roots of the quick, which may be planted in a trench; the plants should be vigorous sets of a year old, having

been once transplanted from the seed-beds, be smooth in the bark and well rooted; they should be placed in the trench at their full length, and at the distance of three inches, covering the roots with a sprinkling of good mould, and the trench filled up with rotten dung; after which the plants should be cut down close to the surface with a sharp knife.

Though most writers reprobate the practice of planting trees among the quick, as tending to cause gaps in the hedge, and though it is admitted that the dropping from a tree greatly injures the subjacent quick, in the opinion of Mr. Billingsley, the beauty and shelter afforded by the sycamore, ash, beech, and pine, compensate fully for the injury they do the fences, and ought never to be dispensed with in exposed situations; and trees and hedges contribute to the improvement of the land, as well as being of themselves of much advantage and profit; for the writer has observed, that the same quantity of manure will do more good on a quiet, warm, sheltered close, than in an open field; and they serve also as a shelter for cattle, and in time supply the occupier with wood for necessary purposes. All deciduous trees are recommended to be planted in October and November, as they will then generally take root before the severe frosts, and consequently be more vigorous the following summer. If the plants should be injured when approaching to maturity, and gaps made in the hedge, it is thought of little service to replant these gaps with young sets, as they seldom thrive; but the only way to make the hedge uniform in such cases is, to select some strong plants from other hedges, or from the nursery, and to put them into such gaps at full length, cutting off the adjacent quick, that the newly-planted sets may have the lead in the next summer; and this should be done in October or November. It is reckoned advisable to lop off the tops of the quick in four or five years to reduce them to a level, and to make them more close and thick at the bottom. The cost of these different kinds of fencing is said to be—the mortar wall 17*s.* 6*d.*—the list wall 15*s.*—the dry wall 10*s.*—and hedges on banks 11*s.* per rope of 20 feet (the measure usually adopted in fencing in the county of Somerset); the particular items of which are given in the Essay.

In the course of fourteen or fifteen years the hedge will probably become loose and irregular in its growth, and then recourse must be had to plashing, an operation too well known to be copied from the Essay; but it is recommended, that in every succeeding cutting of the hedge, the plashes should be laid in a contrary direction to that of the last; that in convertible land this work should be done when the leys are broken up, and in permanent grass land when the crop is to be mowed, that the young shoot may be less exposed to cattle.

Though a very decided preference is given to white-thorn for sets, yet it is stated that many other plants are sometimes substi-

tuted in their places:—1. the *sloe*, which may be taken up in the months of October and November from highways and commons of sufficient size to make an immediate fence; at some seasons of the year it is ornamental, and is in all cases a cheap fence, but cannot be put in competition with the white-thorn, for its roots run out to a distance, and throw out so many shoots, that the progress of the plough is greatly obstructed in arable, and they give an unpleasant appearance to pasture land:—2. the *holly*, which is chiefly objectionable on account of the difficulty of raising and transplanting it, and from the slowness of its growth; it makes, however, a very beautiful and strong fence when at maturity:—3. the *elder*, which must always be considered as an interior fence, and may in some cases be adopted with advantage; but it is hollow and weak, and will not be able to resist cattle with advantage:—4. the *crab* may occasionally be seen forming entire hedges; but it is neither good for shelter nor defence, and if used, brambles should be planted among it to make the fence thick at the bottom, and to prevent cattle from creeping through the stocks:—5. the *furze*, which will succeed on a barren soil and in an exposed situation, and as a fence is not to be despised; the seeds should be sown in April on wide and high banks, in rows about two feet asunder; the young plants require the protection of a dead hedge, and to be carefully weeded:—the *sallow*, which is calculated for the division of low moist lands, where it may be adopted with considerable advantage.

From hedges the writer passes, as it were, naturally to the raising and planting of timber trees, either for ornament, profit, or shelter; and observes that, on hilly situations, though the profit should be trifling, yet it is an essential part of good husbandry; judicious and well-disposed belts and clumps increasing the beauty, as well as value of new inclosures; affording shelter and defence to the fields, as well as being pleasant to the eye, and ultimately profitable; and it is remarked, that on most inclosures pieces of land may be found not well adapted either to corn or grass, on which, as well as in the angles and sides of fields requiring shelter, planting should keep pace with cultivation; for though the time taken up in the growth of trees is considered by many as a formidable objection, and men neglect it till they are at an advanced period of life, and are then checked by the consideration that they shall not live to reap any advantage from it, yet there is no way of providing for children so cheap or so easy as planting; for one acre of nursery-ground, under a proper system of management, will raise trees sufficient to plant a large estate in a few years; and it is suggested that plantations on high grounds may be composed with most advantage of the pinaster, Scotch fir, larch, beech, ash, sycamore, and birch. The directions given for planting are perspicuous; but the most important of all considerations, and that which requires the strictest and most unremitting atten-

tion, is said to be securing such plantations from the approach of cattle, and a stone wall of five feet and a half high is named as the most effectual fence. In transplanting trees of a larger growth, either for ornament, or to form an immediate shelter to buildings, directions are given for causing a trench to be dug round the tree a year before the time of transplanting, at a moderate distance, and so as to amputate the root near the extremities, leaving a large ball about the stump, and for filling up the trench with fresh mould, if it can be procured; in this state the tree is to remain till the succeeding year, by which time a multiplicity of young fibres will have issued from the old amputated roots; the tree should be removed after a severe frost, when the earth sticks to the roots in a firm lump, the principal branches should be shortened, and a hole prepared for the reception of the tree; the ground to receive it should be perfectly thawed, and of sufficient dimensions to admit the whole of the roots; the earth with which it is to be filled should be of good quality, and rather moist, when nothing more will be necessary than to stake it firmly, and cover the root with loose stones.

In marking out the division fences, the writer recommends placing them in the direction of the prevailing winds, as this position will render them less liable to injury from storms and tempests; for the current of air will follow the direction of the hedge, and do less damage than when the nipping blast attacks it in the front; and a hedge so placed will come to maturity many years sooner than one planted in a different order; but it is admitted that hedges in this direction, though they come quicker to maturity, will not so effectually shelter the land in the future progress of occupation; and therefore, should the inclosure be extensive, the fences may be made progressively to keep pace with the cultivation of the land; and the part next the homestead should be first tilled in small inclosures, which may continue to increase in size, as the property becomes more distant; but if grass be the prevailing object, they cannot be well too small, regard being had to the general size of the farm. Some particular directions are subjoined applicable to particular soils, particularly the soil of King's Sedgemoor in Somersetshire, which we shall pass over, as only of local application.

Farm Buildings. The principal object in farm buildings is stated to be convenience; and a comfortable dwelling-house and offices, a good stable, capacious barn, stalling for cattle, small cow and calves house, pig-sties, waggon-house with a granary over, and a poultry-house, seem to the writer to be the principal buildings necessary on an upland or corn and sheep farm; all which he conceives may be erected for 1200*l.*, where stone and lime can be easily obtained, and will be a proper accommodation for four or five hundred acres of land. He advises, particularly in western districts, that the house should have an eastern or south-eastern aspect,

and be built with stone with an oak roof, and slated covering; its dimensions may be 42 feet long, 18 wide, and 22 high, and a shelf-house (or lean-to) may be attached to the back, which will furnish a second kitchen, a dairy, and a cellar. He erected a farm-house and appurtenances of this description a few years ago on Lord Waldegrave's estate on the Mendip hills (in 1802). The house cost 479*l.* 13*s.* 5*d.*; the stable, 60 feet by 20, and 10 feet high, without a hay-loft, 110*l.* 8*s.* 4*d.*; the barn, 64 feet in length, 26 in height, and 22 feet wide, 160*l.* 11*s.*; the opening stalling for cattle and other buildings about 270*l.*—making a total of about *one thousand pounds*. The stable was placed in that part of the farm-yard which is farthest from the dwelling-house, lest fire should be communicated; and at the back of the stable is the hay-stack yard: the barn is placed towards the north, to keep off the cold winds; and, being placed against sloping ground, has stalling for oxen or other cattle under the floor, which is expected to keep sound many years longer than in the common method on account of air circulating under it; and at the same time the depredations of vermin will be in a great measure prevented: the corn is taken into the barn through two sheaf-holes left on the side; for on no account, says Mr. Billingsley, should a waggon be permitted to enter on the threshing-floor of a barn.

Cultivating and Manuring. As most uninclosed lands are incumbered with rocks, loose stones, with furze, fern, heath, or some unprofitable production, it is noticed that these obstructions should be removed before the introduction of the plough, and in calcareous soils the stones may be advantageously consigned to the lime-kiln, and if not calcareous may be applied to making the necessary farm buildings, roads, reservoirs, &c.; and should there be more than sufficient for this purpose, they may be broken into pieces so small as not to obstruct the plough, and spread on the surface of the land, and, if not calcareous, may be thrown into holes too deep for tillage. Furze, ling, or heath, may be gotten rid of by burning on the spot, by carrying it into the farm-yard for manure, or by fagotting and selling it for fuel. When the surface is cleared, and the inequalities levelled, the plough may be set to work; the implement pointed out as most proper for the purpose, is the common foot plough, which differs but little from the Scotch plough; and the best months to begin the operation are October and November: the breadth of the furrow ought not to exceed ten, or the depth five inches. It is directed to leave the fallow rough, to suffer it to remain in that state till March, when it should be cross-ploughed, and afterwards well dragged and harrowed, when the surface will be in a proper state to receive lime, which is considered as one of the most efficacious manures which can be applied to newly broken up lands. When the surface is of too steep an acclivity to be ploughed conveniently, *hacking* is stated to be the common practice, and the men work with their faces towards

the hill, and separating the earth from the rubbish and clods, leave the latter to be burnt on the surface; where the ground is tolerably smooth, *paring* and *burning* is frequently resorted to, as equally efficacious, and much cheaper. This the author considers to be an admirable preparation for a turnip crop, though it has been the fashion for some years to decry this ancient mode of improvement: there are, however, two maxims, which he warmly inculcates, viz.—Never to omit mixing lime (if it can be got at a moderate price) with the burnt ashes—and not to follow up this mode of manuring with many successive crops of corn; but after the account given by Mr. Young in his Essay on Manures (noticed in vol. iii. p. 528 of this work), he forbears entering into its qualities, or discussing its merits. The author mentions a method that is very common in Devonshire, of mixing the lime with weeds and ashes, which he notices with commendation; but the writer considers nothing of greater importance than *early* and *complete* summer fallows; for if the farmer wishes to reap a good crop of wheat from his newly broken up land, he should have his fallows sufficiently forward to begin liming in April, and the land should be in complete order for the last ploughing before the end of July, from which time it should remain to get firm, close, and compact, with all the lime on or very near the surface till the time of sowing; and after the lime is slaked, it should be spread evenly on the surface, and completely mixed with the soil by harrowing and rolling, but not buried under it.

The expense per acre is calculated at 6*l.* 12*s.*; and the original value of the land, including fences, buildings, making roads, and interest of capital till there be a return, being taken at 8*l.* 13*s.* per acre, gives a profit of 8*l.* 15*s.*, supposing the improved value to be 20*s.* per acre, and at twenty-five years purchase. Conceiving, however, that practical results are more convincing than imaginary statements, Mr. Billingsley annexes the amount of expenses and improvements of a farm of Lord Waldegrave's, on the forest of Mendip, of 440 acres, which appears to be 4200*l.* for profit and interest of money, on an expenditure of 4000*l.* upon land of the original value of 2300*l.*

Cropping and Harvesting.—The general practice of having six or seven successive crops of corn upon newly broken up land, without any intervening fallow, or fallow-crop, is severely censured as injudicious and absurd, for if the best meadow were so treated, it would suffer as much, and, perhaps, be more injured than the other; and to counteract this error, the following rotation of crops is suggested, beginning with wheat; it being taken for granted that the tenant enters at Michaelmas, when the ground is fully prepared for the reception of the seed:—1. Wheat;—2. Potatoes, turnips, or cabbage, dunged lightly;—3. Barley or oats with clover-seed;—4. Clover;—5. Wheat on one plough-

ing, and after two mown crops of clover;—6. Vetches and turnips, well dunged;—7. Oats, barley, or buck-wheat;—8. Ray-grass and white Dutch clover, fed;—9. The same mown;—10. The same fed and manured with lime and earth;—11. The same mown;—12. Oats on one ploughing of the ley;—13. Vetches and turnips, well dunged, or pease;—14. Barley, or white oats and seeds. It is conceived that by fourteen years tillage in this manner, the land will be entirely cleaned from furze and fern, and cannot fail of being productive, if it has received all the dung which the stables and yards can supply; and that this rotation may be carried on with increasing fertility through many other similar courses: and it is laid down as an axiom to be strictly adhered to in husbandry—*Never to have two white corn crops in succession.*

A detailed account is then given of the expenditure and receipts during the first seven years of the course which has been recommended, and the recapitulation of profits gives £12 per acre for the period: a similar account is added of the usual course of corn crops, from which results a profit of *only* six shillings for the same period; and it is observed, that at the conclusion of this unprofitable course of cropping the vigour of the land is, comparatively, gone; and that a repetition of it for seven years, can be viewed only with apprehension and dismay; with a probability of bankruptcy to the tenant, and of deterioration of rent to the landlord; and the land in a state of almost irrecoverable exhaustion.

The prevailing predilection for corn crops is attributed principally to insufficient capital; as a farmer in this situation generally sets the plough to work without mercy, and as soon as his crops are harvested they must go to market, be the price whatever it may; and every practical farmer knows that on all poor upland farms, grass (if the soil be favourable) is more profitable than corn, because the expense of cropping arable land is certain, but the return uncertain; and the writer believes, that the fewer acres a farmer has in tillage, the more corn he may raise, at least, to a certain extent, and that ten acres under a masterly system will produce more grain than twenty acres slovenly managed. So far, however, from excluding the plough, he considers a proper proportion of arable with pasture land, to be both useful and necessary, as furnishing straw for the cattle in the winter season, and manure for the fallow crops, and he recommends that the proportion should in no case exceed one third part.

Though the management of grass-land is more simple than that of corn, yet the subject is not dismissed without some observations. It is remarked that artificial grass generally thrives on newly-cultivated lands manured with lime, and though broad clover takes the lead, yet ray-grass and white Dutch are best calculated for permanent sweard: it is recommended to sow the

seeds very thick, and not to mow more of the newly laid down lands than what is necessary to supply the working cattle and sheep with provender: and the whole is concluded with the following maxim:—"*Let the prudent farmer have no more corn than is necessary to renovate his old pastures, and to supply the farm-yard with straw.*"—He is advised to mow as little ground as possible; to keep no winter stock on his newly-sown artificial grasses, but in summer to keep on all his pastures and vetches, as many cattle and sheep as will eat up the vetches clean, and keep the pastures short and sweet; to make as much dung as possible in his yards; and this may be increased in summer by driving all his fatting cattle into the yards in the daytime, and feeding them with cut vetches; to apply his dung to his fallows for turnips, and manure his grass-lands with a compost of lime, earth, &c.; and to be particularly attentive to the preparation of his land for the fallow crops of vetches and turnips. With respect to the proper mode of consuming these crops, the writer remarks that the vetches appropriated to the sheep should be hurdled off, a small quantity at a time, and the ground ploughed and sown as fast as they are fed off; and in cutting them for the cattle to eat in the yards, it is necessary to take the precaution of mowing them one complete day and night before they are used, which will prevent inflation, to which ruminating animals are subject, when eating green and succulent food. Turnips, he apprehends, ought to be consumed on the land where they grow, on flinty, stone-brash, and sandy soils, and indeed in all cases where farm-yard manure has not been used in the raising them; but on clays and many sorts of loam, where the sheep would injure the land by poaching it, they should be carted off, which may also be done wherever an ample manuring has been given.

For the black mountainous earth of the Mendip hills, a particular course of husbandry is recommended; but as this can be only of local interest, it is sufficient to notice, that it consists chiefly of liming and planting potatoes, as a means of rendering the soil sufficiently tenacious for buck-wheat, which, as well as potatoes, is represented to be a profitable crop.

The SUCCEEDING MANAGEMENT, it is taken for granted, may be sufficiently understood from these observations, and no distinct remarks are given on the subject; but some MISCELLANEOUS OBSERVATIONS are added, which are deserving of notice.

The proprietor, who contemplates a new inclosure, is reminded that a *nursery* should be the first preparatory work, where he may raise his trees and sets, and that he should next provide a competent sum of money to enable him to proceed without restraint or embarrassment; and then to give unremitting personal attendance; and Mr. Marshall's observation is repeated, "that farmer *Self-attendance* is the best farmer." To the gentleman-farmer, it is recommended to do every thing by contract, which

can be so executed, and to acquire an honest and capable bailiff, and a good shepherd, and not to be above consulting with them. And though the time of sowing must vary with the soil and the season, yet wheat should be sown from the middle of September to the middle of October, as this early sowing brings the crop to ripen early in August. The necessity of attention to seed corn is strongly inculcated, and the expediency of changing it, and obtaining seed from a more southerly and warmer climate, is impressively enforced. It is spoken of as an excellent mode of harvesting to bind not only the wheat, but also the barley and oats into sheaves, and to secure every day's cutting in the evening by setting it in shocks. And as nothing contributes more to the improvement of a country than good roads, it is represented as inexcusable not to pay them the most marked attention, and to stone public roads at least twenty feet wide, and private ones about sixteen. Pools should also be provided to retain water, and a lime-kiln be built if the soil be calcareous: and the nicest accuracy of accounts is insisted on, if the farmer wishes to know his profits and his loss, or to profit by his past experience; and this subject is considered of so much importance by Mr. Billingsley, that he concludes his Essay by intimating to the Society his intention at some future period to communicate his sentiments to them more at large.

Observations.—Instead of giving our own opinions respecting the advantage to be derived both by individuals and the public from the division and improvement of the waste lands and commons of the kingdom, we conceive that we shall perform a duty more acceptable, by deviating on the present occasion from our established rule, and subjoining, instead of our own, the sentiments of Sir John Sinclair, which received the approbation of the House of Commons, and were printed by their order at the close of the year 1795.

"Whoever," says he, "has taken the trouble of perusing the Reports, transmitted to the Board of Agriculture by its different surveyors, will not be surprised to find that the passing of a general Inclosure Bill should be uniformly mentioned, as the first and most essential means of promoting the general improvement of the country; and the importance of that measure has not as yet, perhaps, been so distinctly stated as it deserves. In general, those who make any observations on the improvement of land, reckon alone on the advantages which the landlord reaps from an increased income, whereas, in a national point of view, it is not the addition to the rent, but to the produce of the country, that is to be taken into consideration. It is for want of attending to this important distinction, that people are so insensible of the wonderful prosperity that must be the certain result of domestic

improvement. They look at the rental merely, which, like the hide, is of little value compared to the carcase that was inclosed in it. Besides, the produce is not the only circumstance to be considered;—that produce, by the art of the manufacturer, may be made infinitely more valuable than it originally was. For instance: if Great Britain by improving its wool, either in respect to quantity or quality, could add a million to the rent-rolls of the proprietors of the country, that, according to the common ideas upon the subject, is all the advantage that would be derived from the improvement: but that is far from being all—the additional income to the landlord could only arise from at least twice the additional produce to the farmer, consequently the total value of the wool could not be estimated at less than two millions; and as the manufacturer by his art would treble the value of the raw material, the nation would be ultimately benefited in the amount of six millions per annum. It is thus that internal improvements are so infinitely superior in point of solid profit, to that which foreign commerce produces. In the one case lists of numerous vessels loaded with foreign commodities, and the splendid accounts transmitted from the Custom-house, dazzle the understanding; whereas in the other case the operation goes on slowly but surely. The nation finds itself rich and happy, and often attributes that wealth and prosperity to foreign commerce and distant possessions, which properly ought to be placed to the account of internal industry and exertion. It is not meant by these observations to go the length that some might contend for; namely, to give any check to foreign commerce, from which so much public benefit is derived, but it surely is desirable that internal improvement should at least be considered as an object fully as much entitled to attention, as distant speculations; and when they come in competition, evidently to be preferred.

"There are some, however, who, although they are ready to acknowledge that the improvement of the soil is the best source of national wealth, yet have formed an idea that very little of the extensive wastes in the island are worth the cultivating, who are too apt to imagine that the climate in which they are situated is hostile to improvement; and, were it better, that the nature and quality of the soil are obstacles not to be surmounted.

"In regard to the climate of such wastes, it is evidently worse in consequence of the want of cultivation.—At the same time, from the insular situation of Great Britain, the climate is infinitely milder and better than in any part of the continent of the same latitude. It is stated in the Report of Forfarshire that very fine barley and oats ripen in due season on the summit of a hill in that county, elevated 700 feet above the level of the sea, and that in Inverness-shire, at an elevation of 900 feet above the same level, wheat of a good quality has been grown. Hence it may be inferred that grain, and other articles of a similar na-

ture, may be raised to such a height on the sides and summits of all the hills in the island; and in regard to grass, it is well known that luxuriant crops of hay are obtained on the Lead Hills in Lanarkshire, elevated 1500 feet above the sea. The climate of this country therefore can hardly be urged as an objection to the improvement of the greater part of our wastes, either for grain or grass; as to trees, it is not questioned that the larch grows in Italy, on higher mountains than any we have in this island.

"In regard to the soil, though the greater part of the wastes, having never received any advantage from the labour of man, are at present of little value, yet the portion is not very considerable, that ought to be accounted totally barren and unprofitable, or incapable of yielding some useful and valuable production: one twenty-second part of the whole, or a million of acres, is certainly an adequate allowance.

"This leads me shortly to state the various purposes to which the remainder of such wastes may be appropriated.

"1. The higher situated and the most sterile parts ought undoubtedly to be devoted to plantations. There is scarcely any spot, however rocky, or any soil, however unproductive, that will not yield valuable timber—an article which at present we are under the necessity of importing at a great expense from foreign countries. At first sight it may seem surprising that a spot that would not produce a single blade of corn, will yet support the stately pine, or the spreading oak. But trees draw their nourishment from sources beyond the reach of smaller vegetable productions, and by their leaves are also supposed to derive additional sustenance from the air that surrounds them, or the water they imbibe. By plantations also, even barren spots may in process of time be rendered fertile. The poorest soils, if covered with wood, from the leaves which fall, and the shelter they receive, improve every year in fertility, and when the trees are ready for the axe, become, in process of time, fit for cultivation.

"2. Many of the higher wastes in the island might easily be rendered perfectly dry, and soon converted into excellent upland pasture. There that valuable article, fine clothing wool, might be grown in perfection. The loftier the situation, and the shorter the herbage, the more valuable it would be; and the price which the article bears, joined to the profit of the carcase on which it grew, would amply compensate for all the expense of the improvement.

"3. A much greater proportion of the wastes of this country, than is commonly imagined, might be converted into tillage. The surface may appear barren and unproductive, but stratums may be found below, which, if incorporated with the soil above, may render it sufficiently fertile. This is a practice in husbandry, which has not been carried in any degree to the extent of which it is capable. It is an art pretty much in its infancy, and, when

brought to perfection, must be productive of the most important consequences. As such it will naturally call for the particular attention of the Board of Agriculture, to ascertain the principles on which it can best be conducted.

"4. A considerable proportion of the wastes of Great Britain consists of lands of a wet and boggy nature, which it has been yet supposed was the most difficult to improve and cultivate. Fortunately, however, discoveries have been made in the art of draining such bogs, by Mr. Joseph Elkington, a farmer, in the county of Warwick, as renders the improvement of swampy land a matter of much less difficulty or expense than formerly. It is only necessary to add, under this head, that Mr. Elkington has communicated his system of draining to the Board of Agriculture. Bogs drained on Mr. Elkington's principles soon become of very great value as meadows, and in many cases may be converted into arable lands.

"Lastly, at least a million of acres of the waste lands in the kingdom may certainly be brought to an astonishing height of produce by watering or irrigation. This great means of improvement, though long established in some parts of the kingdom, yet in others has been unaccountably neglected. But when once that art has been extended as it deserves, the advantages thence to be derived cannot easily be calculated; for by it land is not only rendered perpetually fertile, without manure, but the luxuriant crops which it raises, produces manure for enriching other fields; and the manure obtained from that produce is another source of national wealth, that could not otherwise be looked for.

"Thus there is every reason to believe that the wastes of this kingdom, if planted, or appropriated for pasture lands, or cultivated for the production of grain, or converted into meadow, or improved by the means of irrigation; must necessarily be the source of infinite wealth and benefit to this country.

"And if there is a possibility of improving our wastes, the means for that purpose are more abundantly in our power than perhaps in that of any other country in the universe. Without entering much at length into so wide a field, it may be sufficient to remark that there is none with such a capital capable of being devoted to so useful and profitable an object;—none where such a spirit of exertion exists, were all obstacles to the improvement of our wastes removed;—none where there is such a mass of knowledge on agricultural subjects;—none where there are such abundance of manures to be found, particularly those of a fossil and mineral nature, without the aid of which it would be impossible to bring great quantities of waste lands rapidly into cultivation;—and, lastly, none, where by means of a series of excellent roads and canals every where rapidly extending, such manures can be so easily and cheaply conveyed to the lands they are calculated to fertilize. These are

advantages for improving wastes, which no other country enjoys in equal perfection, and which would soon be the means of cultivation of a very large proportion indeed of our at present useless territory, if full scope were given to the industry and exertions of the people. Nor ought the wealth to be derived from the improvement of our wastes to be alone taken into consideration. The increase of population, and above all of that description of persons who are justly acknowledged to be the most valuable subjects that any government can boast of, merits to be particularly mentioned. His mind must, indeed, be callous, who feels himself uninterested in measures, by which not only the barren waste is made to smile, but of which the object is to fill the desert with a hardy, laborious, and respectable race of inhabitants, the real strength of a country; being the fruitful nursery, not only of our husbandmen, but also of the fleets, the armies, and the artists of the nation. The additional number of inhabitants, who might thus receive occupation and subsistence, cannot easily be ascertained; but if the present population of Great Britain amounts to about ten millions, these wastes and commons, properly improved, might be the means of adding at least from two to three millions —a number, it may be proper to observe, equal to that possessed by the United States of America, when they first erected the standard of independence against the mother-country. The evils were then felt from the creation of such an extent of population at a distance; but from such an increase of people at home, instead of similar consequences being to be apprehended, additional strength and prosperity of every description may be looked for with certainty.

"There is another point of view, in which this subject ought also to be considered. The improvement of wastes not only adds to the wealth and population of a state, but also renders it more defensible. An inclosed country is, perhaps, the strongest of any. Every hedge and ditch becomes a rampart, through which an enemy cannot easily penetrate, and which there is little difficulty in defending. Were this kingdom completely inclosed, and no opportunity afforded of fighting any pitched battle (the only thing to be dreaded in the event of an invasion), we should have little reason to apprehend the landing of any body of men, however numerous, or however well disciplined: they might do some mischief on the coast, but could never penetrate into the interior of an inclosed country. The best defence the capital can have is not to suffer a spot of uninclosed ground to remain between it and the coasts in its neighbourhood.

"Before concluding, it is necessary to take notice of one important circumstance. For some years past this kingdom has been under the necessity of importing grain from other countries; and the importation seeming to increase, rather than otherwise, it was seriously apprehended that the agriculture of this island could not

furnish grain sufficient for the use of its inhabitants. Many reasons may be assigned for the scarcity of grain; the seasons since 1754 have certainly been in general unfavourable. We have seldom had two successive good seasons, but often two successive bad ones. To this natural cause may be added the increased population, consumption and luxury of the people, and the greater attention that has been paid of late to the improvement of stock; in consequence of which, considerable tracts of arable land have been converted into pasture. This, instead of being a public loss, was undoubtedly a national benefit. Land, that for ages had been kept in tillage and produced but scanty crops of grain, required rest, and was usefully appropriated for pasture. But to complete the policy of this system, at the same time that arable land was converted into pasture, pasture land ought to have been rendered arable; and every acre of waste land fit for that purpose which had remained untilled, perhaps from the creation, would have soon repaid the labours of the husbandman, by whom it was brought into culture.

"Nor is the quantity of land, the cultivation of which would prevent the necessity of importing foreign grain, so considerable as is commonly imagined. The importation from foreign countries for eighteen years, ending 5th of January 1789, amounted only to 767,841 quarters of wheat, and 5,097,166 quarters of oats, rye, beans, &c., which is at the rate of 42,657 quarters of wheat, and 283,175 quarters of oats, &c. per annum. The extent of ground which it would require to raise that quantity of grain cannot be calculated at more than one hundred thousand acres. Let us then only convert that quantity of pasture into tillage, or indeed devote only $\frac{1}{180}$th part of our waste lands for that purpose, and the business, in so far as respects the existing population of the kingdom, is effected.

"When it is considered the high prices which grain and other articles of provision bear at present, which have been rather increasing than otherwise for some years past, and the consequences which might arise, were these articles to become still scarcer and more expensive, it surely cannot require any additional arguments to prove the necessity of not losing an instant in taking such measures as may be thought most advisable for the purpose of acquiring from extensive tracts, situated in the very bosom of our country, the certain means of national subsistence and prosperity."

Whoever is convinced by the preceding observations of Sir John Sinclair, which, though written in 1795, are equally, if not more strongly applicable to 1808, of the necessity, the importance, and the advantage of cultivating waste lands, cannot resort to a better guide for carrying his intentions into effect than the Essay of Mr. Billingsley, which has been honoured with their prize medal by the Bath Society. The instructions are the result of

long observation and experience, and may be resorted to with implicit confidence. The whole Essay is a valuable system of practical agriculture, and reflects credit both on the Author, and the Society who have patronized it, and given it to the Public.

An Account of the Manufacture of two Pieces of Navy Blue Broad Cloth for the Premium of the Society, with the Report of the Committee, and a Letter from Dr. PARRY, *containing further Observations on his Wool.—Bath Society's Papers, Vol. II.*

THESE two pieces of cloth were manufactured by Messrs. Yeats and Son, of Monks-mill, near Wooton-under-Edge; one of them being made from wool grown in England by Dr. Parry on Merino-Ryeland sheep, and the other from prime Leonesa Spanish wool of the coronet pile. The weight of Dr. Parry's wool, in every different state, is given in a table in the account, and the weight of the wool manufactured, when dyed blue and picked, was 42 lb. 8 oz.: an equal weight of the coronet pile of Spanish was taken from the picker, and the same people were employed on both the cloths from beginning to end; they were made with yarn of the same size, were wove by the same weaver, set the same breadth in the loom; and in every part of the manufacture the same attention and work were given to each. The British wool, though not so well scoured, held better in the spinning than the Spanish; and when the two cloths were taken off the loom, there was the difference of only six ounces in weight, Dr. Parry's cloth weighing 44 lb. 6 oz., and the counter piece made with the coronet exactly 44 lb.; but when they were simply scoured out of the grease, the British cloth weighed 35 lb. 8 oz. and the coronet 38 lb. which gives 2 lb. 14 oz. more yolk left in the British than in the Spanish wool. The length of Dr. Parry's cloth made with 41 lb. 8 oz. of stuff was 26 yards and 12 nails; and the length of the coronet made with 44 lb. of stuff was 27 yards and 6 nails; from which it appears that 41 lb. 8 oz. of British wool have made the same quantity of cloth, within ten nails, as 44 lb. of Spanish wool; and Messrs. Yeats and Son do not scruple to say, that in their opinion as manufacturers the cloth made with the British wool, and marked with Dr. Parry's name, is decidedly of the finest quality.

The Committee of the Society appointed to examine cloth and wool at their annual meeting in 1806, minutely inspected the comparative quality of these two pieces of cloth in conjunction with several woollen-drapers of the city of Bath, and adjudged that Dr. Parry's cloth was entitled to a preference in respect to fineness of wool to the Spanish; they examined also a piece of blue cloth manufactured by Mr. Joyce, from Lord Somerville's wool, which they declared to be equal in every respect to the generality of cloths made with the best wool imported from Spain; and they

were decidedly of opinion, "that Dr. Parry had by his zeal, diligence, perseverance, and activity, accomplished the grand object of producing in the soil and climate of Britain wool equal to that usually imported from Spain; and that in so doing he merits the warmest thanks of the country in general, and of the Society in particular."

The Doctor, in a letter to the Society, informs them, that the wool manufactured for the prize cloth by Messrs. Yates consisted of ewes' fleeces from his own flock, descended from Ryeland ewes crossed with the rams of the King and Lord Somerville to the fourth generation, and he has no doubt but that the cloth would have been finer, but for the ignorance of the wool-sorter, who mixed with the finest several pieces of a coarser kind. He avails himself of the same opportunity of declining the premium, perfectly satisfied with the concurrence of the Committee and the manufacturers in the superior fineness of his cloth; and takes leave to state to the Society, that the sheep producing these fleeces were kept in excellent order for a full year before shearing, having been fed in the respective seasons, not only with grass and hay, but with vetches, clover, cabbages, potatoes, linseed, and oil-cake, observing that some judgment may be formed as to their state of health, when it is known that three only out of one hundred and two died from the time of ramming in September to shearing in the succeeding June, and two of these were killed by scouring from gorging themselves with boiled potatoes mixed with salt.

Observations.—By the statement given in this paper (and there are other occurrences within our knowledge to the same purport), the fact appears to be established beyond a doubt, that cloth may be manufactured from our native wool fully equal in fineness and durability to the cloth made from the very best wools of Spain: and the proof of this fact is chiefly owing to the discrimination and perseverance of the King in importing Spanish rams; for though the finest wool has not been produced by His Majesty, yet the facilities he has afforded to others of obtaining crosses from the Merino breed of sheep have enabled most of our agriculturists, who have turned their attention to that point, to commence the experiments which have led to so fortunate a result. The value of fine British wool, particularly the Merino-Ryeland, is now fully admitted by our manufacturers, and Dr. Parry and Lord Somerville have performed an acceptable service to their country in having their own wool manufactured in counter pieces to cloth made from Spanish wool, for without this positive demonstration, the trader would scarcely have been induced to believe what it was his interest to discredit; for so long as he could purchase the finest British wool at a lower price and mix it with the Spanish, his profits must have been considerably enhanced. Dr. Parry, in his

Essay on the Merino race of sheep and the Merino-Ryelands, which was published in the Communications to the Board of Agriculture, and which has been noticed in the preceding part of this volume, complains that the difficulty of sale of the finest wool is among the principal impediments to its more extended growth. As friends to the *staple manufacture* of our own country, we have much satisfaction in announcing that the evil complained of by Dr. Parry has been since, in a great degree, removed, and chiefly by the exertions of Lord Somerville; for Mr. Sadler, at his repository near Smithfield, has established an annual sale by auction solely for Spanish and Merino-Ryeland wool grown in Great Britain. The sale in the summer, which was the first, was well attended by manufacturers, the wool obtained higher prices than had been before given, and the manufacturers pledged themselves to attend and support the undertaking at the next periodical return of the sale of wool.

On the Wheat Moth, or Virginia Fly; communicated by Mr. Matthews, *of Bath.—Bath Society's Papers, Vol. II.*

This paper, which gives an account of the wheat moth, or Virginia fly, as it appeared in France in the year 1755, and which damaged the grain in the township of Lower Dublin (in America) in 1802, 1803, and 1804, was originally published in America; but it appearing to Mr. Matthews to be of so much importance to be generally known, he was induced to lay it before the Society; and the general meeting having fully concurred in the importance of the publication, directed it to be inserted among their *original* papers.

It is stated that the inhabitants of a considerable part of the province of Angoumois in France had for a period of thirty years sustained great loss from the ravages of this insect, which appeared at first only in a few hamlets, but soon made a very extensive progress; in 1755 Messrs. Duhamel and Tillet were deputed by the Academy of Sciences at Paris to inquire into its nature, and the means of preventing its calamitous effects. These gentlemen described it as resembling the moth which preys upon woollen cloths, and to be of the same species as the four-winged phalenæ, or night-butterflies: the only function of the insect in this shape is to propagate its species; they couple in the manner of the silk-worm butterfly, and as soon as the female is impregnated, she lays her eggs in great numbers, accompanied with a viscous matter, which causes them to adhere to the places they are laid in, and are so extremely small as to drop through a hole made in paper with a fine needle. The females, which are upon the ears of corn, endeavour to lay their eggs close to the joining of the grain to the stalk; and in six or seven days each produces a caterpillar in

appearance like a bit of hair, about the twentieth part of an inch long, at first reddish, but afterwards almost white: when the caterpillars are hatched, they penetrate into the grain for food, and the hole by which they enter can only be perceived by a little bran which lies upon it, and may easily escape observation. The people of Angoumois believed that the mischief occasioned by the insect was peculiar to their country; but to clear up this point Messrs. Duhamel and Tillet put wheat of other countries into glasses with these insects, and they deposited their eggs upon the grains without distinction; the caterpillar was afterwards hatched, and made its way into them. The same gentlemen proved by further observations that the spreading of the evil arises from the conveying to other parts the grain in which the insect is enclosed. The various processes of the transformation of the insect are described with a minuteness, which must be highly acceptable to the naturalist, but which will not readily admit of compression; the different modes of destroying them must not however be passed over. Part of the eggs and young caterpillars may certainly be destroyed by the flail and winnow, if used soon after harvest; floating the grain does not effectually separate the damaged from the sound, for that in which the caterpillar has not eaten much of the flour will sink with the good, and the insect remain to finish its work, which is rendered more easy by the softening of the grain in the water; the best method is supposed to be grinding the whole produce of the crop immediately after harvest, though this cannot be relied on as effectual; for though the friction of the millstones should destroy most of the insects, yet it is not certain but that some of them may escape, and go through their transformations in the flour. From visiting granaries at different hours of the day and night, Messrs. Duhamel and Tillet perceived, that though the butterflies upon the heaps stirred a little during the day, yet they did not quit them till after sunset, when they rose and settled on the walls, and many took their flight through the windows; several methods were resorted to for discovering what became of them, but to no purpose, till they accidentally discovered a few dead and dried ones entangled in spiders' webs: this circumstance led to the discovery they were in quest of; for reflecting that these insects, which neither they nor any other person could discover in the daytime, must be of the phalenæ or nocturnal kind, they visited the fields in the night with a candle and lantern, and soon descried a great number of the butterflies they were seeking for upon the beards of the ears of wheat, but when they returned in the morning, were not able to find a single one. To prove whether the caterpillars could live underground, and pass the winter enclosed in the grain in which they were sown, and afterwards undergo the various transformations, recourse was had to the following experiment. A wooden box was provided, and separated into three divisions, filled with com-

mon mould out of a garden, and wheat known to be infected was planted an inch deep in one of these partitions, two inches deep in another, and three inches in the third, and all of them covered with a glass frame; butterflies soon appeared in each division, but the greatest number in that where the corn was only one inch deep; the experiment was repeated with stiffer earth, wetted and pressed down, and no butterflies appeared there; from whence Messrs. Duhamel and Tillet concluded that the number of insects which come out of the ploughed ground is comparatively small, and that mills and granaries are the great source of their increase; besides, as was proved by the last experiment, the butterflies cannot pierce through a close and hardened earth, which is generally the case with ploughed lands exposed to winter rains. It is not determined what grain these insects prefer, as they attack indiscriminately wheat, rye, barley, oats, and Indian corn.

To preserve the grain from injury after it is reaped, it should be threshed out as soon as possible, and whatever is preserved for either seed or grinding be dried in an oven or kiln, with a heat of 124 degrees of Fahrenheit's thermometer, which is stated to be strong enough to kill the caterpillars, without destroying the vegetative principle; or the grain may be prepared by being soaked in a strong lye of wood ashes and quick-lime, heated so as the finger can just bear it, in which it should remain about two minutes, and then be spread very thin on a floor to dry. The roller is thought to be of use in preventing the fly from making its escape from the ground; and barley may be prepared by pickling it in the same way as wheat. But whenever this insect infects a country, the remedy, to be *effectual*, must be *universal*.

Observations.—Though this insect is at present unknown in Great Britain, yet it is proper and important to record the mischief it occasions, and the remedy which has been successfully applied in other countries. Since the practice of sowing imported corn is become so extensive, it is hardly possible to escape it, if it prevails generally either on the continent, or in America; and the remedy of pickling the seed-corn, and kiln-drying the rest, is so easy, that they ought never to be omitted, where there appears the slightest cause for suspicion.

An Inquiry whether the pure Merino Breed of Sheep is now necessary in order to maintain the Growth of superfine Wool in Great Britain. By Dr. PARRY, *of Bath.—Bath Society's Papers, Vol. II.*

THE writer commences his inquiry by observing, that an opinion has been for some time industriously propagated, that no cross

breed of sheep can maintain the ultimate fineness of fleece, without having recourse to fresh crosses; this opinion he conceives to be no better founded than the long-established prejudice, "that fine wool could not be produced in Great Britain," of which experience has now demonstrated the falsehood; and considering that the assertion, "that fine wool can be with difficulty preserved," to be a serious and grave proposition, he deems it necessary to investigate the fact in order to arrive at some tolerably certain conclusion; for if after 15 or 20 years assiduous attention to the business of crossing eventually from rams derived from his own mixed stock, a man should have brought his flock to great excellence in carcase, and the greatest possible fineness of wool, and shall then find his fleece begin to degenerate, so that, in order to restore its fineness, he shall be obliged to sacrifice the form by the new introduction of ill-shaped Merinos, who is there that would be mad enough to undertake the hopeless project of forming a beautiful and fine-woolled flock, under the prospect of such dependence and disappointment? Dr. Parry trusts he is enabled to shew that the apprehension has no foundation in truth. He proceeds then to examine what changes are usually produced on any original species of animals by an introduction into other countries, and remarks, that the Norway rat is the same in this country as on the shores of the Baltic, and that the mouse-hunting powers of the cat are the same as in the tenth century, when the value of a cat was established by law in Wales, by Hoel the Good, to be equal to a ewe, her fleece and lamb, taken together; and the ass, as far as we know, is not a native of our island. Among birds also he notices that neither the pheasant, the common fowl, nor the turkey are ancient inhabitants of our soil, and yet no degeneration or decay is discovered in any of these; that the gipsey, originating in Hindostan or Malacca, preserves the distinctive marks of a separate variety of the human race in all latitudes and climates, and that the Finlander and the Laplander maintain their original characteristic difference even on the same soil; and without adding other instances drawn from analogy, which he considers superfluous, observes that, with regard to sheep, it is proved beyond contradiction, that the carding wool of our English breeds is not changed by long residence in the plains of Jamaica, and that there is no evidence of the wool of the Merino sheep having degenerated in Spain, where the race was certainly unknown in the time of the Emperor Trajan; and though the breed is now disseminated through a variety of countries, from New Holland, in the 34th degree of southern latitude, to Sweden, 60 degrees north, and has been introduced into some of them more than forty years, yet the experience of English manufacturers has certified that the wool of all these different countries is not inferior to the best Spanish, and that the Spanish itself is the same as it was as far back as 1723. Hence he concludes

there is no cause for apprehension of any deterioration from length of time in the wool of the pure Merino breed.

With regard to the second point to be considered—the permanence of mixed breeds, he appeals to the well-known and popular example, the race-horse. Britain, it is said, abounded in horses at the invasion of Julius Cæsar, but they probably differed little from the poney of Wales, or the galloway of Scotland; and though two centuries ago the breed was sufficiently increased in size and strength, yet it was not till the middle of the last century, that, on observation of the fleetness, wind, and strength, which were combined in the Turkish and Saracenic breeds, the effect was tried of coupling males of these races with mares of our own country. Breeders continued for many years to cross the female descendants with pure males, till the actual acquirement of the excellencies which were sought for, rendered unnecessary all further intermixture of the pure blood. Yet in horses of this kind there is no degeneracy; they are, on the contrary, superior to the race from which they sprung, and in a constant state of improvement; for while the horses of the Arabs in their own country can scarcely trot or canter 8 or 10 miles without being exhausted, there is hardly a race-horse in England, that will not, with little fatigue, run 20 miles in an hour, almost at full speed. Dr. Parry is therefore decidedly of opinion that this principle, which the experience of half a century has established, on the subject of horses, will be found equally true on that of sheep. "Mr. Bakewell," he says, whom we must justly consider as one of the most enlightened of farmers, "would have laughed to scorn any one who would have told him, that in order to preserve certain points of form or constitution in a breed, it was necessary to revert to animals possessing those points in a less degree than the sheep of his own flock: the observation of his whole life confirmed him in the truth of the contrary principle." That rule then, which holds good with regard to the carcase, may likewise be received as true with respect to the fleece.

The Doctor then relates to the Society what he has learned from sixteen years experience, and the detail may be considered as a proof of the principles which he has advanced, and is far from leading to the conclusion that, when the fineness of the wool of a cross-bred ram is fully established, there is a necessity of recurring to the pure stock; having found no deterioration occur in a whole race of sheep after three or four generations bred in and in, but that the greater part of the progeny appeared to be in an improving state, he thinks we have no right to presume the contrary from supposition only. The greatest stumbling-block appears to him to have originated from observing a sort of gross connexion between the food and the quality of the fleece; it was concluded that the fine herbage of the downs necessarily produced fine wool, and that none but coarse wool could spring from gross luxuriant

food; but neither of these conclusions is true, for the fineness of a sheep's fleece, of a given breed, is inversely as its fatness, and the very same sheep may, at different times, according to these circumstances, have fleeces of all the intermediate qualities from extreme fineness to comparative coarseness. This is given as the true cause of the error, which has prevailed universally, that a Spanish sheep out of Spain cannot yield a fine fleece; but the falsity of this prepossession has been proved by experiment, and experience authorizes the decision that when a race of animals have preserved their peculiar qualities for three or four descents, those qualities may by proper care be preserved to the latest generations, and that those animals are best for breeding which possess those qualities in the highest degree, however they may be denominated, or from whatever country derived.

Observations.—The question respecting the fineness of wool degenerating after repeated crosses, without a fresh intermixture with the pure Merino blood, may be considered as set at rest by Dr. Parry's arguments, confirmed by his experience; and no apprehensions of that kind need disturb the tranquillity of the breeder from the Merino-Ryeland race of sheep.

The Description of an improved Spirit Level, which may be employed with Advantage in the Business of draining and watering Land, &c. with Accounts of two other small, cheap, and convenient Implements, which may be used for the same Purpose, in Cases where less Accuracy is required. By C. B.—*Dickson's Agricultural Magazine, No.* 12.

This instrument is nothing more than a common spirit level with a telescope sight, to which a compass is annexed, and which may be purchased at Troughton's or Cary's, or any optician's who makes levels; the less expensive instrument is a level with theodolite sights, and without any compass; and that for less accurate purposes is a common carpenter's square with a plummet, and the level is ascertained by looking along the edge when the plummet falls into a perpendicular line on the square. The staff described is a plain rod, marked with feet and inches.

Observations.—The instrument is described with a parade of learning and exactness which may captivate the reader unacquainted with mathematical instruments, but the *improvement* spoken of has been adopted by engineers for more than the third of a century, and the use of a carpenter's square in levelling is known to almost every labouring drain-digger in the country. An attempt to make this pass for a new discovery, by giving it the first

place in the number, and illustrating the subject by a plate, is beneath the notice of criticism.

Observations on the Manner in which the Practice of naked Fallowing, or the frequent Exposure of fresh Surfaces of the Soil to the Influence of the Sun and Atmosphere, produces its Effects in improving Land. By PHILAGRICOLA.—*Dickson's Agricultural Magazine, No.* 12.

IT is taken for granted by the writer of this article, that the improvement of the soil, by naked fallowing, is brought about by the decomposition of water diffused through the vegetable mould, and exposed to the action of light, the result of which decomposition is the formation of oleaginous matter, and the *fixation* of carbon and hydrogen in the soil; but as the chemical formation of oils may be also brought about by sheltering the ground from heat with a profusion of vegetables, a preference is given to a productive crop over a naked fallow.

Observations.—These remarks may be easily read over without any discovery of the meaning of the author, though he has contrived to fill ten pages of letter-press with an affectation of chemical and philosophical language, and abundant use of hard words He appeals to the writings of Dr. Priestley, Dr. Ingenhouz, and the Annales de Chimie, for the confirmation of his opinions; but he *forgets to acknowledge* that he is indebted to those valuable publications for all the sense contained in the article.

Questions concerning Beetles and Moles, made with the View of examining whether they are really injurious to the Farmer, or the contrary. By JOHN SAUNDERS, *of Stroud, Gloucestershire.* —*Dickson's Agricultural Magazine, No.* 12.

THE first question is—"Whether are *beetles* most injurious or most beneficial to the farmer?"—and second—"Whether are *moles* most injurious or most beneficial to the farmer?"

As *beetles* subsist principally upon dung, and as they make their appearance as soon as it is dropped from the animal, and quickly reduce the heap to a powder, which they work into the earth, thus incorporating it with the surrounding soil in a more complete manner than the husbandman can effect it with tools; and as this takes place upon grass-land principally, and at a season of the year when dung is most beneficial to such lands, while the dung, if left to the care of man, would be neglected upon the soil, destroy the grass for want of spreading, and lose its virtues by eva-

poration, it is contended that the beetle removes the nuisance, performs the operation, and preserves the dung.

The arguments advanced in favour of the *mole* are, that she exerts labours equally useful by working large heaps of soil above the surface, in a state of perfect pulverization, and leaves nothing to man, but to seasonably scatter them abroad; and so far from destroying the roots of plants, which she severs in her progress, the division makes them shoot the more luxuriantly. And taking notice that Wesley, in his Philosophy, calls volcanoes the *great plough*, which nature makes use of to turn up the bowels of the earth, and afford us fresh food to work upon, when the former are exhausted, so the *mole* may be called the *little plough* of nature, adapted for the same purpose.

Thus he considers the beetle and the mole, "combining their operations, both internally and externally, as *living tools* that meliorate the land!!!"

Observations.—These speculations of Mr. Saunders are more useful to the editor of the Magazine, to whom they furnish a few pages of matter, than to the practical farmer, to whom they offer nothing but speculation. The writer professes himself not unaware that the supercilious glance of ridicule will be levelled against him by some, for venturing to usher into the world what *they* will call an absurd subject, but deprecates animadversion till the discussion be read. We *have read* his discussion, but can discover no reason for depriving him of the ridicule which he anticipates.

On the Wool of Spanish Sheep. By T.—*Dickson's Agricultural Magazine, No.* 12.

As the wools of Spain enjoy so distinguished a reputation, the writer conceives he shall give information to some readers by detailing the various sorts into which Spanish wool is divided. He states that the wool of the travelling flocks is divided into three classes; the first of these is called Segovian Leonese, because it is the produce of the flocks which feed in the neighbourhood of Segovia, Madrid, &c. in Castile, and those of the kingdom of Leon, which pass the winter in Estramadura; the second class is known under the name of Soria, a town in Old Castile, and of Saragossa or Arragon, which province lies adjacent to the preceding one: the third class is the wool of Seville.

The Segovia Leonese is distinguished by piles or heaps, composed of the wools of different flocks, of which the piles of Paular, or the Escurial, of Infantado, and Negrette (formerly that of the Jesuits) are the three most considerable; by these the prices of the others are usually regulated. The second sort, or quality, is

named Segovia, and its piles are denominated Marques, Avila, Armendes, Hospital of Burgos, &c. and this is inferior to the Leonese; and the small Segovia is less fine, and is the medium between those two kinds of wool.

The Soria is inferior to the first kind; the most noted flocks are those of Villa Real, Badillo, Naros, Castelfrio, &c. and this wool is seldom divided into piles.

The different kinds are distinguished by the marks on the bales, to which are added the initials of the different flocks. Most of the wools are white; but Spain produces yellow, black, and brown wool, but this is not picked for exportation. Those wools are stated to be of the best sort, which are long, strong, soft, silky, fine, slender, and glossy, entirely divested of grease, well picked, without mixture and new; the last point is determined by the wool not having a rancid smell, which it contracts by age, and by its dilating or swelling speedily, when compressed in the hand: the strength and pliability are discovered by drawing it with the fore-finger and thumb of each hand; if it be new, it will stretch, not easily be broken, but when it is, will sound neither dry nor sharp. The duty upon Spanish wool imported is given at two-pence halfpenny per pound, and the markets, in January last, are quoted at—Seville, 3*s.* 4*d.* to 5*s.* 3*d.*—Segovia, 6*s.* to 6*s.* 6*d.*—Leonese, 6*s.* 6*d.* to 6*s.* 9*d.* per pound.

Observations.—This short account of the different wools of Spain is a valuable appendage to Dr. Parry's various publications on the subject of wool in the Communications to the Board of Agriculture, and among the papers of the Bath Society, where these terms are frequently mentioned without any explanation, to the great disappointment of the readers. But the mode of sorting, washing, and packing the wool of Spain, as well as the manner of conducting the sales, is much better explained in Dr. Parry's Essay, published by the Agricultural Board, than in this article.

On smothering of Weeds by Broad-cast Hemp, and on the Use of Opiates to Swine. By John Lawrence, *of Somers Town.—Dickson's Agricultural Magazine, No.* 12.

This Mr. Lawrence having asserted, in a paper published in a former number of the Magazine, that it was unnecessary to hoe or weed hemp sown broad-cast, on the presumption that it would destroy or prevent the existence of all other vegetation, in the present article chaunts his *recantation*, and says, "Whether or not I were half asleep while copying that happy notion, it is too late now to determine, but most assuredly at that instant, I no more credited it seriously, than I did that the amount of two and two would be five."

Observations.—After this *modest* avowal of Mr. John Lawrence, of Somers Town, that he has deliberately written and published what he knew to be *false*, we shall not proceed to notice what he says about the use of opiates to swine; and if ever his name should occur again in an agricultural publication, we shall feel justified in passing over the article without notice.

On some Improvements on the Threshing Machine, by which the Breaking of the Straw is prevented; and the Horses or other Animals employed in moving it rendered capable of being suddenly stopped, without stopping the Beaters. By W.—*Dickson's Agricultural Magazine, No.* 13.

These improvements (as they are called) consist in a contrivance, by which the labourer who is engaged in supplying the machine with unthreshed grain, by setting his foot on a treadle, has the power of throwing one of the fluted cylinders out of work, by which means the straw may be drawn out back again after the ears are threshed, and is thus prevented from being broken and rendered useless for a variety of purposes, such as thatching and manufactures; and in a click or catch, by which the horses are capable of being stopped without the least danger or inconvenience to the machinery.

Observations.—If a threshing machine be properly constructed, it will receive no injury from the horses stopping rather suddenly; and as to drawing the straw out back again, it must hinder more than half the work that would be otherwise done. Most certainly straw which has passed through a machine can never be fit for manufactures, but the straw is not at all damaged for thatching or any other purpose by a machine noticed in the present number, which is constructed by Mr. Frost, of Great Linford, Bucks. Had Frost's threshing machine been known to the writer, he might have spared himself the trouble of describing his invention.

On the Choice and Management of Dairy Stock, with a few Observations on the best Method of rearing Calves. By T. S.—*Dickson's Agricultural Magazine, No.* 13.

This *anonymous* essay, though it extends through ten pages, contains nothing new or important. The observations are useful, but are every where known; and all the information contained in the essay appears to have been gleaned from the Agricultural Reports, where the whole of it may be found.

On the Raising and Managing of Hawthorn Hedges, with the View of converting their Berries to the Food of Animals. By JOHN SAUNDERS, *of Stroud, Gloucestershire.—Dickson's Agricultural Magazine, No.* 13.

AFTER some common-place observations on hedges, gleaned from the Reports of the agriculture of different counties, Mr. Saunders asserts that it is with him a doubt whether every row of quick upon a farm in a berry-bearing state (if his *simple* directions were followed) might not be made to yield a great annual return to the farmer, for the *hawthorn produces an abundance of food, or berries, that will subsist and help to fatten both hogs and rabbits!!!*

Observations.—"*Ecce iterum Crispinus!*" Mr. Saunders meets us in every number of the Agricultural Magazine with his reveries, and astonishes us with the *depth* of his researches, and the *usefulness* of his discoveries. The reader will obtain an account of many of his *elaborate* essays by consulting the references in the indexes of our former volumes, under the terms "Food for swine,"—"Food for rabbits,"—"Hay tea,"—"Sunflower seed," &c. &c. But Mr. Saunders's ideas are all confined to *hogs* and *rabbits*.

We perceive, by an advertisement on the cover of a subsequent number of the Magazine, that Mr. Saunders's essays are *republishing* in a volume!!!

On the Means of improving a Piece of poor worn-out Grass-land, and on the coarse Wool of Merino Lambs. By NOTTS.—*Dickson's Agricultural Magazine, No.* 13.

THE writer, in 1803, came into possession of a twelve-acre piece of land, of a poor sandy soil, on a substratum of gravel, which had been mown every year beyond the memory of the oldest inhabitant of the parish. His occupation commenced too late in the spring for any thing to be done that season, but he had only three loads of very indifferent hay; rain however falling in the beginning of August, he ploughed it over, and in September sowed a part of it with winter tares, another part in October, and another in January, and the remainder in March, with summer tares. The part first sown was ready to cut in June, when it was mown in daily portions sufficient for the stock, and thrown into cribs and eaten on the ground where it grew (water being supplied to the cattle in troughs); and when that was cleared, the other parts were disposed of in the same manner in succession. The part first cleared was ploughed twice and sown with turnips,

the second and third parts with rape and turnips mixed, and the last part with rape only. The rape grew well and was fed off with sheep in 1805, and the sheep were removed from the second and third parts before they began the turnips, which were kept till March, when both the rape and turnips were again given to the cattle, and completely cleared by the end of April. He then made a clean fallow, which was finished by the middle of July, and immediately sowed the whole with turnips broadcast, and never had so good a crop. The turnips were eaten off with sheep, and the field sown with barley, in 1806, and laid down with grass seeds; and the produce of the twelve acres was seventy-four quarters of clean barley. The grass seeds succeeded very well, and became a good turf with one complete manuring.

With respect to the Merino lambs, which are very hairy when dropped, and more like a goat than any thing of the sheep kind, the writer asserts, from his own experience, that they will become as fine woolled in the following year as if they had been dropped more woolly, and will produce a progeny equally perfect.

Observations.—The method of renovating worn-out pasture, which is detailed in this paper, is very judicious on light and sandy soil, but where the staple is deep and the land good, a safer method of securing a good turf in future is to manure well with yard dung, and feed the grass off with sheep for three or four years in succession, though this is certainly not so profitable for the time as consigning the field to the plough. The assertion respecting the hairy Merino lambs may remove many apprehensions from the minds of young breeders.

On a Sledge for the Purpose of conveying Rape to the Place where the Seed is to be threshed out, with Remarks on the Construction of Machines of this Nature. By PHILARATOR.—*Dickson's Agricultural Magazine, No.* 14.

THE sledge is made in the common method with two curved pieces of wood, about four feet asunder, which are planked over with thin boards, and four standards are mortised into each of them, about five feet high, which are bound together at the top by a slight rail, and withinside each of them is fixed a strong iron hook, on which the sheet or sail-cloth is suspended, on which the rape is laid; and in this manner the rape is conveyed to the place where it is threshed, which is usually in the middle of the field. The writer remarks that he has frequently witnessed a great want of discretion in conducting this business. The seed is often allowed to remain accumulating to perhaps an inch in depth, before it is shifted into sacks, the consequence of which is, that a large quantity is inevitably dispersed by the strokes of the flails,

and injured by being trodden under foot by the threshers. It is recommended to allow the chaff to remain upon the seed to the depth of two inches, to prevent the flail from injuring it by bruising, and to keep it from scattering; for it is not necessary that the flail should come in contact with the pod to force out the seed, as the great caution used in cutting, laying, and removing it on the sledge should convince us that a very slight action of the flail must be sufficient to force out the grains.

Observations.—These remarks are rather practical than deep; they shew however that the writer understands his subject, and his caution about keeping the seed covered with chaff, to prevent its being either bruised or scattered by the flail, will be found to deserve very general attention.

On a supposed successful Imposition in a Northern Publication, and on Smut. By L. L.—*Dickson's Agricultural Magazine, No.* 14.

The writer remarks, that pickling seed wheat is the present fashionable practice, and, like all other fashions, is strenuously advocated by those who have adopted it. He states that the practice was first introduced into Great Britain in the reign of James the Second, when brining and liming were generally adopted, and continued to be well received till the time of Ellis, the writer on husbandry (about 1708), when clean washing wheat with water was substituted chiefly on his recommendation. In the reign of George the First, there happened several universally blighting seasons, when the steeps got quite out of repute, and destroyed the credit of their advocates, till the doctrine was inculcated that the brine was not strong enough, nor the seed steeped a sufficient length of time. From the various interruptions and changes of steeps it is argued that the practice itself is futile, and unworthy of preserving, and it is more than hinted (with not much liberality) that the Scots defend the practice entirely from their prejudices.

Observations.—When this writer accuses the Scots of defending their prejudices with warmth and conceit, he should at least have preserved his own temper, and have remembered that his former article on the subject provoked the animadversions which appeared in the Farmer's Magazine. It must be allowed (by any man not in anger) that *brining* separates the light grains, and is *so far* useful, without any reference at all to the destruction of the smut.

On the Raising and Planting of Apple-trees for Cyder. By D. M. —*Dickson's Agricultural Magazine, No.* 14.

As the apple-tree is of great importance to the farmer in districts where cyder forms the principal produce of the farm, it is necessary to obtain a constant supply of young trees. It is recommended to plant them on a dry soil, and with a south or south-eastern aspect, on account of the coldness of the west and north-west winds. Early fruits are said to arrive at the greatest perfection in a sandy soil, and the latter ones to answer best in a strong loam or clay; the more valuable fruits, the styre, hagloe, crab, and golden pippin, prefer a light soil. The grafts are directed to be taken from a crab, and not from a degenerated apple, for the former will possess much of the hardiness and vigour, while the latter will generally inherit all the diseases of the parent tree. The autumn is named as the best time for planting.

Observations.—Though the remarks in this paper are not new, yet they appear to be founded on practical knowledge, and are deserving the attention of young planters, who are seldom versed in the management of fruit-trees, unless they reside in the cyder counties.

Observations upon the Culture of Beans. By Z.—*Dickson's Agricultural Magazine, No.* 14.

These observations relate to the proper depth of planting the seed; and it is stated that though the land, on which peas and tares may be cultivated, does not require so deep a staple as that appropriated to beans, yet all these seeds should not be placed at a less depth in the earth than five or six inches below the settled surface, for it will appear on inspection, when the plant has attained maturity, that from the point where the seed was deposited in the ground, it sends downwards a long slender tap root, and upwards a thick strong one. Hence the necessity for placing the bean a proper depth in the ground, that the plant may not be deprived of its proper organ for receiving and conveying from the earth that portion of nourishment which the bean requires.

Observations.—The information to be drawn from this article is so generally known, and indeed so trivial in itself, as not to have merited insertion in the Magazine.

On the Perfections and Superiority of the Leicestershire Breed of Sheep. By Mr. JOHN HUNT, *of Loughborough.—Dickson's Agricultural Magazine, No.* 14.

As private interest is evidently the secret motive of the first movers, whenever any speculation is brought forward, where the popularity of the proposal is necessary for the accomplishment of the design, though the public good is always represented as the grand object; Mr. Hunt, having noticed the great exertions lately made for introducing the Merino sheep into this country, hopes it will not be thought useless to guard the credulous and inattentive against the influence of great names, and the dangers of misrepresentation. Without attempting to account for the taste which may induce one person to prefer the Leicestershire, another the Lincolnshire, another the South Down, and a fourth the Merino, the writer apprehends it would be necessary to estimate the coincidence between the nature of the animal, and that of the situation to which it is intended to be removed. He is of opinion that if a male and female Merino sheep were brought into Leicestershire, in a few years the nature of their offspring would become subservient to local circumstances, even if no crossing took place, that the carcase would improve and the wool become coarser; and also that by removing the Leicestershire sheep into Spain, the wool would in time become similar to the natural production of the country, and would be a great improvement to the Spanish stock. He allows that the inhabitants of every country are in general characteristic of its situation, but remarks that the productions of warm climates are seldom improved by being removed northwards: "Exotic plants may be protected in a hot-house, but never can be made congenial to the soil;" and he infers that, setting aside local considerations, if the Merino sheep are not superior to the Leicestershire, the connexion must evidently prove injurious to the breed of which we are already in possession. He does not think it necessary to inform those, who are prejudiced in favour of crossing, that the breed will not be improved, unless the cross is made by one of superior perfection; and after all that Mr. Cline has said about Arabian horses and Flanders mares, he is of opinion that selections might have been made from our own breeds with more advantage. If indeed a *rapid* change were wanted, it might be necessary to procure an animal of a different character, and perhaps the easiest means might be importation; but it appears to him more reasonable to suppose that improvement is more likely to be obtained by a proper selection from those who are accustomed to the climate, situation, and pasturage, and though the progress might be slow, the success would be more certain.

Mr. Bakewell, he remarks, had many local advantages, and was too well acquainted with them to send to Spain for sheep; and though his own stock was at first as uncultivated as others, yet his knowledge of domestic animals was so correct, as that he seldom failed of accomplishing his object, and to this he was indebted for the perfection to which he brought his breed of sheep: his improvement in sheep was not the speculation of a day, but the business of a whole life, and to all who are acquainted with the subject, there cannot remain a doubt but that the Disbley breed of sheep is by far the most profitable animal of the kind that the strictest attention to the improvement of domestic animals has yet been able to produce, and that for lightness of bone, small quantity of offal, and expedition of converting vegetable into animal food, their equals are not yet known; and with respect to the fineness of the wool, that, on barren pastures, might also be obtained.

To give a comprehensive representation, he conceives it would be necessary to take a view of the origin of enclosures, and the progress of agriculture for the last century, but this is beyond the limits of his design; he remarks however, that Mr. Bakewell was the first agriculturist who preserved for stock such of his sheep as shewed the earliest disposition to fatten, instead of condemning them first to the slaughter, as was, and is still too much, the general practice, because they will obtain the highest price; and he ventures to assert, that if no other improvement had been made, than the preservation of the best and the slaughtering the worst, a considerable improvement would have been made. In pursuing the progress of Mr. Bakewell's improvements, he notices that this celebrated breeder always selected his sheep from his own flock, *because he knew them to be the best,* and indeed he soon arrived at that perfection, as to find none equally good elsewhere; and this perfection is attributed to a judicious selection of the breeding stock, and not to crossing them with other kinds. He observes, that the increasing population dictated at once the necessity of enclosure, and increased the demand for animal food, as a change of living gradually took place among all orders of society; and an improved cultivation of the soil might be naturally expected to lead to an improvement in the stock that fed upon it; that Mr. Bakewell's superior discernment enabled him to accomplish in a short period, what would otherwise have been a work of much longer time; and that the advantages obtained by that gentleman were not limited to the more immediate objects of his attention, improvement of carcase, and converting the greatest quantity of vegetable into animal food in the shortest time; but that instead of a small fleece of fine wool, which was the produce of the fallow field, we are now furnished with a larger quantity of wool of a coarser quality. He proceeds:—

"The argument then will become plain and self-evident, that if

the fine wool, which was the production of a fallow field or barren forest, was rendered coarse by luxurious pasturage, there cannot remain a doubt that by converting the luxurious pasturage to what would be equivalent to a barren forest or fallow field, the quality of the wool might be again restored;" and he is of opinion that this might be accomplished without any diminution of vegetation, merely by increasing the quantity of stock. He says there are at this time large quantities of fine wool grown on Charnwood forest; he has no doubt that the quantity might be doubled, if the breed of sheep and quantity of stock were attended to; and that if a quantity of sheep were taken from Dishley to Charnwood forest, they would lose in carcase, and the fineness of the wool increase; or if a flock were brought from Charnwood to Dishley, the carcase would immediately improve, and the wool become coarse: he does not know that there is more than one breed of sheep in Scotland and the western islands, yet in the inland parts the wool is in general coarse, but in the Shetlands as fine as the produce of Spain: "it is to management and situation (he says) that we must look for character."

Nor does he consider it sufficient that we go to Spain for sheep, if fine wool be the object, for it will be necessary to bring the climate, soil, and pasturage with them, if the *character* is to be preserved; yet he has no doubt that if a Dishley ram was to be taken to Spain, the breed might be improved, as the Merino sheep are now in a state of uncultivated nature, and the Leicestershire breed in the zenith of perfection; and that it must inevitably follow, if Merino rams become general in this country, the high degree of perfection we have now to boast of will again sink into degeneracy. "But if the character of the Merino sheep could be preserved, and we were to furnish this country with large flocks of this grand importation, they would then eat up an immense quantity of herbage, for which we should receive a small quantity of lean Spanish mutton in return; and for giving up that plentiful supply of animal food, on which the poor are fed, and which may be considered as affording provision for half the country, we should have in compensation nothing but the loss of our own fat into the bargain; and all for the sake of covering our lean sides with a fine coat of Spanish wool.

The highly ornamented descriptions of Spanish flocks which are found in agricultural publications are commented on with much severity, and the elegant plates of Spanish rams are spoken of as baits to take in the unwary. Many judicious remarks are made on the publication of Mr. Cline (which was noticed in a former volume), and the following observation of that eminent anatomist is quoted in confirmation of the writer's opinion:—"*that attempts to improve the native animals of a country by any plan of crossing should be made with the greatest caution, for by a mistaken practice, extensively pursued, irreparable mischief may be done.*"

Mr. Hunt congratulates himself on the coincidence between the sentiments of so competent a judge, and his own opinions; and, considering that the Dishley breed of sheep have been in a progressive state of improvement for more than half a century, and that the Merino sheep still remain in a state of uncultivated nature, he concludes by stating his conviction that the Merino sheep might be improved by sending Leicestershire rams to Spain; and at the same time it appears to him equally evident that irreparable mischief may be done by the introduction of Spanish sheep into this country.

Observations.—The inquiry whether the introduction of the Merino race of sheep may tend to lessen the quantity of human food produced in the country, without any other compensation in return than enabling us to wear a finer garment, is a question of political economy not within the province of the RETROSPECT. But in forming any comparison between the Merino and Leicestershire breeds of sheep, and of the advantages to be derived from each in a national point of view, it is necessary to remember that the object which Mr. Bakewell had in view, was very different from that of the agriculturists who patronize the breeding of sheep from Spanish rams, but that both may be equally meritorious, and both deserve equally well of their country; for both equally endeavoured to remove those wants, which their country more particularly felt at the times when the respective attempts were made. About the middle of the last century, the vast increase of the population of the kingdom called for a larger proportion of food for human subsistence, and this increase was certainly promoted by Mr. Bakewell in a degree beyond that which was attained by any of his contemporaries; and at the period when the importation of Spanish sheep was most strenuously recommended, a protracted war had prevented our manufacturers from obtaining that supply of fine wool from Spain, which was necessary for the employment of their usual workmen; and surely it was meritorious to attempt a removal of the evil, and judicious to employ means which were well adapted to prevent its recurrence. How much soever we may owe to Mr. Bakewell for those improvements in the breed of sheep, which will hand down his name with honour to the latest ages; it is by no means a necessary consequence that we should condemn the importation of Spanish sheep, which have not been introduced to supersede Mr. Bakewell's improvements, but for a very different purpose. As to the evil apprehended by the too great importation occupying those pastures which ought to supply us with food, it is an evil that will correct itself; whenever it shall be less profitable to the farmer to grow fine wool, than to obtain fat mutton, the former object will give place to the latter, as it did in the time of Bakewell, when the short wool of the fallow fields

gave place to the well-fed carcases of the luxuriant pastures; and the same effect will be again produced, when the same cause demands the change, whether the fine wool grows on the backs of sheep of English or of Spanish extraction.

With respect to an intimate relation subsisting between the fleece of a sheep and the quantity of food it is permitted to consume, the belief of it is contrary to the best authenticated experiments. The publications of Dr. Parry on this subject (several of which are noticed in this volume) are the most numerous, as well as the most correct, and he gives it as the result of sixteen years experience that no such deterioration takes place: Dr. Parry's experience, however, is confined to the neighbourhood of Bath, the hills of Gloucestershire, and the plains of Wiltshire, a district which approaches nearer than any other part of England to the mountainous provinces of Leon and Arragon in Spain. He continues the system of crossing no longer than the requisite fineness of wool is obtained, and expressly states that farther perseverance is injurious both to the wool and the carcase of the animal, and his crosses are limited to that English breed which approaches nearest to the Spanish, the Ryeland; and transferring them to Bath, can scarcely be called a change of situation. The observations suggested by this article diverge into so many branches, that a sense of duty only, and regard to the design of this publication, prevent our pursuing them. It is, however, but justice to Mr. Hunt to observe that his reasoning is clear, his remarks judicious, his motives (as far as they can be judged of) praiseworthy and patriotic, and his warm defence of the honour and name of his departed neighbour and friend is worthy the man who enjoyed the friendship of Mr. Bakewell.

Reply to the additional Remarks of G. B. on Wheel Carriages. By ARATOR.—*Dickson's Agricultural Magazine, No.* 12.

Reply to Philarator's Remarks on Iron Axle-trees. By T. S.—*Dickson's Agricultural Magazine, No.* 12.

Reply of G. B. *to the Remarks of Londinensis.—Dickson's Agricultural Magazine, No.* 12.

Reply of G. B. *to the Observations of Arator on the Subject of Wheel Carriages.—Dickson's Agricultural Magazine, No* 13.

On Wheel Carriages. By ARATOR.—*Dickson's Agricultural Magaziue, No.* 14.

THESE *five* papers on wheel carriages are of a controversial nature; and as they are all *anonymous*, and contain neither novelty nor information, are uninteresting to every body, but the doughty disputants.

Use of Mr. Lumbert's newly-invented Mole-plough. By the Rev. JOHN PLAMPIN, *of Chadacre Hall, Suffolk.—Annals of Agriculture, No.* 268.

THIS *newly-invented* mole-plough is precisely the same implement as has been known by that name for the last twenty years, and the *novelty* consists in the plough being preceded and followed by a roller, which keeps the mole part of the implement at the same regular depth beneath the surface, and in the plough being drawn forward by one horse yoked to a capstan, round the axis of which the chain turns, which draws the plough forward: the capstan is moveable, and the force of the plough is resisted by an iron hook in the shape of an anchor.

Observations.—At the first thought this appears an *improvement* on the mole-plough, which was originally made, though there is no right to claim it as a new invention; but upon reflection, it is difficult to say without practical experience, whether the complexity of the apparatus does not more than counterbalance any advantage to arise from the diminution of the working power.

Method of making Cyder in the County of Kirkcudbright. By FILL BASKET.—*Farmer's Magazine, No.* 35.

ACCORDING to the method here described the apples were reduced to mucilage by beating them in a stone trough (one of those used at pumps for watering horses) with pieces of ash poles used in the same manner as potatoes are mashed. The substitute resorted to for a press was a strong box three feet square and twenty inches deep, perforated on each side with small auger-holes, which was placed on a frame of wood projecting three inches beyond the base of the box. A groove was made in this projection, which conveyed the juice when pressed out of the box into a receiving pail. In performing the operation, the box was filled alternately with layers of apple-pulp of two inches thick and of straw one inch thick, and care was taken to prevent the straw and pulp from reaching exactly to the sides of the box, that there might be the more room left for the expressed juice to run off. The necessary pressure was obtained by a double lever on the lid of the box, both the levers being fixed in the fulcrum, and that nearest the box pressing downwards, and the other upwards, at the end of which a weight was suspended to give the power: as the lever forced down the lid of the box, additional blocks of wood

were placed on the top of the lid to enable the lever to act even after the lid had been compressed within the box. The liquor thus obtained was allowed to stand twelve hours undisturbed in open vessels to deposit its sediment; after which it was put into clean casks to ferment in a temperature of from 55 to 60 degrees. If the fermentation began early and proceeded rapidly, the liquor was racked off in two or three days, but otherwise it remained unracked for five or six days; and in all cases, in racking off the liquor, every precaution was taken to keep it free from sediment, and from the scum or yeast produced by fermentation. The barrels when finally closed were stopped up closely, and the bung secured with resin to prevent the admission of air. If the cyder be weak, nine months is named as the proper time for it to remain in the cask, but if strong, twelve or eighteen months are thought necessary before it is bottled.

Observations.—The plain and simple method of making cyder, which is detailed in this paper, is as effectual as any other, and the means employed are in every one's power. It is a valuable and practical communication, and will amply repay the time bestowed in perusing it, to those who wish to make cyder on a small scale, and are unacquainted with the process, and unprovided with the usual implements.

On the Disease in Dogs called the Distemper. By a KINCARDINESHIRE FREEHOLDER.—*Farmer's Magazine, No. 35.*

As a farmer generally values his dog next to his wife and his horse, any apology is held unnecessary for obtruding this paper upon an agricultural publication. It is noticed that the disease called *the distemper* is more accurately described by Dr. Blane than by any other writer, and that his medicines have proved more successful than those of any other person; but they yet very often fail of producing a cure, and the valuable animal dies a miserable and lingering death. The gentleman who communicated this paper to the Magazine, had administered the Doctor's medicines to a favourite pointer, but with no avail; the unvarying symptoms had come on, when the poor animal crawled into the field and fell among some grass, attempting, but in vain, to eat it. He followed the suggestion of nature, and ordered a handful of grass to be cut in shreds of about half an inch long, and when mixed with butter to be put down the animal's throat: the dose was repeated three times in every twenty-four hours, and a visible amendment almost immediately took place, which terminated in recovery.

He admits the case to be a solitary one; but as the remedy appeared to him to be pointed out by nature, he considered it to

merit attention, and made it public, that the efficacy of this simple medicine might obtain a fair and unprejudiced trial.

Observations.—The remedy suggested in this article for a disease which so often proves fatal as the distemper, and deprives both the farmer and sportsman of a valuable attendant, is deserving of trial whenever an opportunity is afforded of administering it. It is certain that it can do no harm; and nature not unfrequently works the greatest effects by the simplest means.

On the Utility of Summer Fallows, and a proper Rotation of Crops, as Antidotes for the Diseases of Corn Plants. By J. B.—Farmer's Magazine, No. 35.

It is observed that the art of raising upon the soil grain and other plants in the greatest possible degree of perfection and abundance is the chief study of every agriculturist; and that this is to be accomplished by putting the soil into a state of fertility, keeping the crops free from disease, and allowing no weeds to rob them of the nourishment which the soil is capable of affording.

To put the soil into a state of fertility, its deficiencies must be rectified by art; and as the component parts of fertile soils are understood to be clay, sand, and calcareous earth, mixed in such proportions as that they be neither too close nor too porous; the art is to add manure of such kind and in such quantity as shall place the land in the most fertile state possible. When land is in this state, the best means of keeping it so are said to be a proper rotation of crops, and fallowing the ground when necessary during the summer months. But as a proper rotation of crops, and of the time of fallowing, can only be acquired by a knowledge of the physical causes which render these operations necessary; it is presumed that this is best acquired by studying the nature of plants, and the diseases to which they are liable. The diseases of animals have long been a principal study with mankind, but the diseases of plants have been little attended to, though these decay and perish as frequently from sickness, as from want of fertility in the soil. It is stated that a proper rotation of crops and fallowing will be found to be a remedy for many of these diseases; —those to which this mode is an antidote are divided into two classes;—1. such as attack the stems and leaves;—and, 2. such as attack the root. The former are compared to cutaneous disorders in animals, the latter to diseases in the intestines; the former the most frequent, the latter the most deadly and most difficult to eradicate. Cutaneous diseases in plants are attributed chiefly to insects, which in their caterpillar state are frequently so small as

to be discerned only with a glass, and yet so numerous as to suck out the juice of the plant, and consequently occasion disease and sometimes death. To counteract the attacks of these formidable enemies, it is recommended to destroy the food on which they are nourished, which is said to be more easily accomplished than may at first sight appear; for as few insects, that generate above ground, can live upon a variety of plants, and as the greater number can only exist upon one plant, or plants of a similar nature, this fact puts these enemies much in our power. If a field of cabbage, for instance, be infected with the caterpillar of the white butterfly, to repeat the crop of cabbages would only be to increase the number of ravagers; but sow the field with grain, and they must all perish, for the fly can obtain no proper deposit for her eggs: if the wheat crop be infected with rust, follow up the rotation with a green crop, and the animalcula must perish for want of nourishment. By these means a farmer may free his fields from all destructive insects, that breed above ground, and at the same time, by a judicious intermixture of the drill system, in a great measure annihilate the weeds by hoeing.

But these means are not found to be equally successful in the destruction of insects not annually produced from seeds or eggs; for these are mostly generated below ground, and affect the roots of plants, and numerous tribes of them exist as grubs for years. When once these have got possession of the land they are not easily driven out, though a summer fallow is the best remedy yet discovered, but it must not be executed in a slovenly manner. To have its proper effect, the second furrow should be given in April, and not a weed be suffered to remain upon it for some months after; and by frequently ploughing and harrowing the soil, not only an opportunity is afforded to rooks and other birds to pick up the grubs, but they are also starved for want of food, if no roots of weeds are suffered to remain; but winter ploughing is useless in this point of view, as grubs then lie dormant, and require no food, but cannot exist without it, when they are warmed by the genial heat of summer; they then rise near the surface, and may be destroyed.

Many observations are subjoined on the antiquity of fallowing the ground, which practice existed as early as the sojourning of the Israelites in Egypt, and prevailed both among the Greeks and Romans; and much is said on the expediency of clauses in leases to enforce fallows, but these restrictions are held to be unnecessary, if the secrets of nature were investigated and attended to: and the same opinion is maintained with respect to covenants binding a tenant to an invariable rotation of crops.

It is admitted that plants are liable to disease, and fall into decay, from some causes, over which a rotation of crops or fallow have no influence, such as soil or climate; but these are considered by the writer as foreign to his purpose.

Observations.—This is a sensible and judicious paper, reflecting credit upon its author. The expediency, and indeed necessity, of summer fallows in particular cases, is placed on a foundation which no sophisticated reasoning can subvert. The remark that the diseases of plants have been too negligently passed over, while those of animals have attracted such general attention, ought to convey a useful lesson to the husbandman, who blindly adheres to a favourite system, without being able to give the reasons for his predilection. And as the writer has suggested an analogy between the effects of disease on plants and animals, it may be permitted to observe, that health is as necessary to the perfection of the former as of the latter, and that decay and degeneracy are equally the consequences of its absence in both. This subject has been illustrated and proved from experiments with equal ingenuity and plainness by a physician of the name of Ingenhouz, who has given to the public the result of his researches in an octavo volume, entitled "Experiments on Vegetables," which has been printed both in Germany and England in the languages of the respective countries, and has been favourably received in both. The article which has given rise to these observations will afford much information to the uninformed, and no little pleasure to the well-read agriculturist. It ought not to be classed among the generality of anonymous communications.

Thoughts concerning the Mode of ploughing and harrowing Land in wet Weather. By R. M.—*Farmer's Magazine, No. 35.*

The mode of ploughing recommended as most judicious in wet weather, is, to fix the chain of draught so far on one side the plough-beam, as that the horses in passing along the furrow may not tread at all upon the land which has been ploughed; and the mode of harrowing recommended for the same purpose is to fix three harrows to a strong pole of sufficient length to reach across the land, and then yoke the horses to the two extremities of the pole, so that they may walk only in the furrows which divide the ridges; the inconvenience of turning three harrows being avoided by turning upon the second land to that which is left harrowed.

Observations.—In those districts where the horses in the plough-team walk in one line, or at length, as it is called, the precaution recommended for wet weather is unnecessary, as they never tread on the land which has been ploughed; but where the horses go abreast, all the contrivance is necessary to effect this object which is pointed out in this paper. The mode of harrowing by fixing the harrows to a long pole is new, and it is apprehended must be found inconvenient in practice; it is however deserving of farther trial.

HORTICULTURE.

An Account of a Method of hastening the Maturation of Grapes. By JOHN WILLIAMS, *Esq.—Horticultural Transactions, Vol. I. Part* 2.

THE remark, that vines, when exposed in this climate to the open air, ripen their fruit with difficulty, even on south walls, and with every advantage of culture, is generally admitted by gardeners, but yet it must be received with some exceptions, particularly in regard to the white muscadine and the black cluster. Mr. Williams, however, had taken notice that the vines which ripened the fruit thus early were old trees, having trunks eight or ten feet high, before their bearing branches commenced; and it occurred to him that this might be occasioned by the dryness and rigidity of the vessels of the old trunk obstructing the circulation of that portion of the sap which is supposed to descend from the leaf.

In order to prove whether this conjecture was correct, he made incisions through the bark on the trunks of several vines in his garden, removing a circle of bark from each, and leaving the naked alburnum above an inch in width completely exposed; this was done in June and July; the fruit came to greater perfection, ripening a fortnight or three weeks earlier; but the vines did not shoot so well in the succeeding spring, and he found that he had injured them by exposing the alburnum unnecessarily. The following summer he repeated the experiments, but took off circles of bark somewhat less than a quarter of an inch in width; and when the bark had been removed a fortnight, the berries began evidently to swell faster than on another tree which had remained untouched, and indicated ripeness in the beginning of September, and were perfectly ripe by the end of the month, while those on other trees were still green; and in every case where the bark had been removed, he invariably found that the fruit not only ripened earlier, but that the berries were considerably larger than usual, and more highly flavoured.

These effects are accounted for on Mr. Knight's theory of the downward circulation of the sap, the truth of which these experiments tend to confirm. It is considered a material point gained in the culture of the vine to be able to bring the fruit to perfection by so simple and easy a process. The best time for performing the operation on vines growing in the open air, is said to be the end of July or beginning of August, and it is represented as a material point not to let the removed circle of bark be too wide; from an eighth to a quarter of an inch is held sufficient, as the exposed alburnum will then again be covered with new bark before the

following winter, and the health of the tree will not be endangered. It is said to be of no consequence in what part of the tree the incision is made; but if the trunk be large, it is better to make the circles on the smaller branches, and all the shoots which come from the vine below the incision should be carefully removed. The method is represented to be equally successful in forwarding the grapes in forcing-houses, where the removed circles may be wider than on vines growing in the open air; but it is recommended not to perform the operation at all upon weak trees. And in all cases it is important that the bark be completely removed to the alburnum; otherwise, in a very short space of time, the communication is again established with the root, and little or no effect produced.

Observations.—This mode of forwarding the ripening of grapes, which are so seldom obtained in perfection in our variable climate, deserves to be more extensively tried, and, when it has stood the test of experience, to be generally adopted. The cause is easily accounted for from admitting the theory of the descent of the sap from the leaves to the root, for the removed circle of bark cuts off the communication, and diverts the sap into another channel. There is, however, reason to fear, that, if practised for a succession of years on the whole tree, the general health of the plant may be endangered, and it will be most prudent to confine the operation to some of the branches till the effect of many repetitions of the experiment on the same tree can be more clearly ascertained.

Description of a Forcing-house for Grapes, with Observations on the best Method of constructing them for other Fruits. By T. A. Knight, *Esq. F. R. S.—Horticultural Transactions, Vol. I. Part* 2.

Among the various opinions which prevail among gardeners, as to the proper form of a forcing-house, "it is sufficiently evident," says Mr. Knight, "that when the same fruit is to be ripened in the same climate and season of the year, one peculiar form must be superior to every other;" and it appears to him that in our climate, where sunshine and natural heat do not abound, the form which admits the greatest quantity of light through the least breadth of glass, and which affords the greatest regular heat with the least expenditure of fuel, must be the best. According to these previously established principles, he pronounces most of the forms now used for forcing-houses, to be very imperfect, and describes a vinery, constructed to meet this principle. It being known that the sun operates most powerfully in the forcing-house,

when the rays fall perpendicularly on the root; and as the rays fall most powerfully on the root, when the light comes almost perpendicularly on the glass, it is important to know by what elevation of the roof the greatest quantity of light can be made to pass through it. To ascertain this point, he made many experiments, and the result of them has satisfied him, that the best elevation in the latitude of 52 degrees, is about that of 34 degrees, considering the different situation of the sun at different periods of the year. The vinery which he has made is placed at this elevation, and the building, which is forty feet long, is heated by a single fire-place; the flue goes entirely round without touching the walls, and in the front a space of two feet is left between the flue and the wall, in the middle of which space the vines, which are trained to the roofs about eleven inches from the glass, are planted; and as both the wall and the flue are placed on arches, the vines are enabled to extend their roots in every direction. The air is usually admitted at the ends only, where all the sashes are made to slide, but in the roof only about four feet of the upper end of every third light is made to lift up by hinges to give air in the event of very hot and calm weather; and this method of giving air is preferred to the usual one of letting the lights slide down, because, when the former method is adopted, no additional shade is thrown on the plants.

Though this plan is particularly recommended only for a vinery, yet the writer is confident that by sinking the front wall below the level of the ground, and making a small change in the form of the bark-bed, the same elevation of roof of 34 degrees may be made equally applicable to the pine-stove, and that no upright front glass ought in any case whatever to be used, since light can always be more beneficially admitted by adding to the length of the roof, and much expense saved both in the building and fuel: but for forcing peaches and nectarines any house of the dimensions of this vinery is considered improper.

It is remarked that the vine often bleeds profusely when pruned in an improper season, or accidentally wounded; and as any effectual mode of stopping the sap is not generally known, Mr. Knight mentions the following, which he has practised with success for many years. He takes four parts of scraped cheese, and one of calcined oyster-shells, and presses this composition strongly into the pores of the wood, and it will instantly stop the flowing of the sap: the largest branches may of course be taken off at any season of the year with safety.

Observations.—When it is known that the principles on which a forcing-house ought to be built are founded on the immutable laws of optics, and that there is the authority of Mr. Knight for asserting that experiment under his direction has fully confirmed

the theory, there is no occasion for any farther recommendation of the elevation for a vinery, or pine-stove, which is pointed out in this paper, which, to prevent misconceptions, we repeat to be —that the sloping glass roof shall meet the floor or base at an angle of *thirty-four* degrees, without any upright front wall whatever.

Observations on the different Species of Dahlia, and the best Method of cultivating them in Great Britain. By R. A. SALISBURY, *Esq. F. R. S. &c.—Horticultural Transactions, Vol. I. Part 2.*

As no flower more beautiful than the dahlia has been recently introduced into this country, and as by management it may be made to commence flowering in October, a period when most other plants are decaying, Mr. Salisbury conceived that he should fulfil one of the objects of the Society, by offering them the result of his experience in the cultivation of this showy flower.

The earliest account which he could trace of this genus of plants, which are all natives of Mexico, he found in Hernandez's History of that country, published in 1651, where two species are figured, one of which is said to grow on the mountains of Quanahuac, and has leaves composed of five leaflets, some of which are sinuated, slender peduncles, with pale-red stellated flowers; the roots are tuberous, strong and bitter in taste; and an ounce in weight, taken internally, is stated to be a powerful medicine, alleviating pains in the bowels, expelling flatulence, increasing the urinary discharge, promoting sweat, strengthening cold languid stomachs, excellent against the colic, resolving obstructions, and dissipating tumours, if externally applied; this is evidently the pale-red variety of dahlia sambucifolia: of the second species Hernandez gives no description, but calls it acocotli ligustici facié; the figure however leaves no doubt of its being the dahlia bidentifolia. This flower is next mentioned by M. Thiery Menonville, the botanist employed by the French minister to steal the cochineal insect from the Spaniards. The entertaining detail of his journey to Guaxaca was published in 1787, in which he relates that, in this dangerous mission, having entered one of the gardens in the suburbs of that city, adjoining to a plantation of nopals, upon which the insect feeds, he was struck with the beautiful appearance of the flower. The third author who gives an account of these plants is the late Abbé Cavanilles, who first gave them the Linnean name of dahlia, and published a drawing of the dahlia sambucifolia, which flowered at Madrid in October 1790: the name of dahlia was conferred in honour of Andrew Dahl, a Swedish botanist of eminence. The specific name added by Cavanilles was *pinnata*, and two varieties, which flowered afterwards, he called *rosea*

and *coccinea*. These three having been sent to Paris in 1802, an ample memoir, with coloured figures, was published by Monsieur Thouin, in the *Annales du Muséum d'Histoire naturelle*; and he makes the fourth writer on the subject. M. Thouin states them to be perennials, losing their stems at the approach of winter, and not pushing forth again till the spring, that their roots consist of fleshy tubers, disposed like those of the asphodel. M. Thouin, as soon as he received the roots, planted them in large pots of substantial earth, and protected them from frost under a frame, but the stems grew little till summer commenced, when they grew considerably and flowered in autumn; one was seven feet high, the other four, and the flowers of different colours. After paying some handsome compliments to Cavanilles, he describes the treatment best adapted to them, and, being ignorant of their local situation in Mexico, doubts whether they would live through the winter in the open air at Paris. Professor Willdenow, in his republication of the "Species Plantarum," also notices this flower, but unwarrantably changes the name, under the pretence that another dahlia was already established in the class dicœcia, which is an assertion not founded in truth, but originating in a mistake.

Mr. Salisbury, having given this slight outline of the notice taken of the dahlia by foreign writers, proceeds to notice the introduction of the plant into this country; he first describes the genus, species, and varieties, *botanically*, and then offers some observations on the cultivation, following, in this respect, the plan of Philip Miller. For this botanical description, the more curious reader is referred to the original paper, where he will find the plant described with scientific precision, and we merely notice that *three* species are mentioned;—dahlia sambucifolia—dahlia sphondyliifolia—and dahlia bidentifolia.

The first species is said to have been introduced into this country by Lady Holland, who sent the seeds from Madrid in May 1804, which have produced all the varieties mentioned in the description, with many intermediate tints, for which reason Mr. Salisbury has rejected the specific names,—*rosea* and *purpurea*, adopted by Mons. Thouin. From these seeds, which arrived in May, several plants flowered at Holland House the following autumn, and some new seeds ripened there in 1805, were obtained by the writer; he had however no opportunity of sowing them till the beginning of May 1806, when they were put in two pots of light rich earth, plunged to their rims in a bed of dung, which had nearly lost its heat: a dozen of plants soon came up, and were transplanted on the first of June, being then about five inches high, into very small separate pots, in which they remained three weeks, when two of the strongest were removed, without breaking any of their fibres, into large pots with very rich mould; these were again transplanted before the tenth of August, by

which time the largest were four feet high, and the others nearly as much; and were all removed from the hot-bed frame, having been previously exposed to the open air both day and night for a month. Their stems and branches were secured from the winds, and a necessary quantity of water supplied; they grew rapidly in August and September, but shewed no signs of flowering till the middle of the latter month, when every branch terminated in a flower-bud, the first of which was developed on the seventh of October, and a regular succession appeared on some of the plants till the beginning of December, when a violent storm entirely destroyed them. All the plants ripened seed, and were suffered to remain in the ground till a frost came, when they were removed to the green-house, except two, which were covered over with moss on the borders. The green-house plants were again removed into the open air on the 27th of April, at which time they were just beginning to push, and turned out of the pots into different parts of the garden, as well as into different soils, and some were in dry sand and some in pure gravel, freed from large stones. This was done in consequence of those plants which were in the smallest pots the preceding summer, having not only flowered the earliest, but made the handsomest plants. A similar result was experienced to that of the preceding year, but with a still more decided advantage to the plants in screened gravel; one of these opened its first flower on the 19th of August, while one of the largest of the others had not flowered on the 14th of October, and remained in great beauty till the middle of November, though the plants at Holland House, and at Messrs. Lee and Kennedy's, at Hammersmith, had been already blasted by the frosty weather. The superiority is accounted for from the elevated situation of Mill Hill, the residence of Mr. Salisbury, where many green-house plants, particularly myrtles, flourish well, and have done so for half a century, in the open air.

It is conceived that no intelligent gardener can, after reading this account, find any difficulty in the culture of the dahlia, nor is there the smallest doubt that the flowers may be brought to perfection in our climate by checking the luxuriant growth of the stalk; the only necessary caution inculcated is—that in whatever soil they are planted, especially if it be poor and gravelly, they must be duly watered in dry weather, till the flower can be discovered in the heart of the leaves, after which they will not require it.

The seeds of the second and third species of dahlia were also sent along with those of the first by Lady Holland, but one plant of the dahlia sphondyliifolia had been previously introduced from Paris by Mr. Woodford, and flowered in his garden at Vauxhall, in 1803. Both these species are stated to be more tender and to flower later than the first, so that they require every help which art can give to forward them in the spring. The mode of treat-

ment suggested, and which was successful at Mill Hill, is to keep them always in pots, except a plant is wanted to be much branched for making cuttings. After the first of April, their growth should be accelerated by plunging the pots in an airy frame, with a little dung at the bottom, to accustom them to the air and light; and about the middle of June, the pots should be removed into the garden, and plunged into the borders close to a south-east or south wall, nailing up the branches as they shoot; water should be given daily, but they should be protected by a covering from the heavy storms of rain, which frequently fall in autumn in this country.

Observations.—The cultivator of the flower-garden will find a highly seasoned treat in this paper of Mr. Salisbury on the culture of the dahlia. This plant is at present to be found only in the gardens of the favoured few, but its beauty will render it universally esteemed, and its cultivation will consequently become every year more and more extended. Mr. Salisbury has acquired no less celebrity for his skill in the cultivation of flowers, than Mr. Knight has obtained for his intimate acquaintance with the culture and improvement of fruits. The directions given by this experienced florist for raising and perfecting the dahlia are too plain and perspicuous to be misunderstood, and his authority is decisive of the reliance to be placed on them. As, however, the dahlia is cultivated at present in so few gardens, a plate of the plant in flower would have been a valuable accompaniment to the interesting description of it.

On a new Method of training Fruit-trees. By Thomas Andrew Knight, *Esq. F. R. S. &c.——Horticultural Transactions, Vol. I. Part 2.*

This gentleman was induced, from the experiments which he had made to ascertain the influence of gravitation on the descending sap of trees, to believe that none of the forms in which fruit-trees are generally trained, are those best calculated to promote an equal distribution of the circulating fluids, so as to produce permanent health and vigour, with power to afford a succession of abundant crops. He was led therefore to adopt a different mode of training from any which he had seen; and as this method was attended with the most complete success, he thought a description of it would not be unacceptable to the Horticultural Society. The account given in this communication is confined to the peach-tree, though Mr. K. expresses his conviction that the same mode, with a little variation, is applicable, even with superior advantages, to the cherry, plum, and pear; and observes, that when trees by any means are deprived of the motion which their

branches naturally receive from winds, the forms in which they are trained operate more powerfully on their permanent health and vigour than is generally imagined.

The peach-trees, which are the subject of this paper, were plants of one year old only, and were headed down as usual early in the spring, and two shoots only were trained from each stem in opposite directions, and in an elevation of above five degrees; and when either of the two shoots did not grow with equal luxuriance, Mr. K. either depressed the strongest, or gave a greater elevation to the weakest, by which means both were made to acquire and to preserve an equal degree of vigour. These shoots grew with great luxuriance, as they received the whole sap of the plant, and in the course of the summer attained the length of four feet, many lateral shoots being also emitted from the luxuriant branches, which however were all pinched off at the second leaf, and in the succeeding winter were pruned down close. This form, it is observed, might be advantageously given to trees in the nursery, as it would require very little trouble or expense.

As many branches were suffered to spring from each shoot in the succeeding season, as could be conveniently trained without shading each other; and by selecting the strongest and earliest buds towards the points of the last year's branches, and the weakest and latest near their base, nearly an equal degree of vigour was obtained to each shoot in the year; and by this method also a greater surface of leaf was exposed to the light, without placing any of the leaves so as to shade others, than could have been effected by any other method of training; and the growth of the trees was so great from this arrangement that some of them at two years old were fifteen feet wide, and the young acquired in every part the most perfect maturity. In the succeeding winter the shoots of the last season were alternately shortened and left their whole length, and were then prepared to afford an abundant and regular blossom in the succeeding spring. In the autumn of the third year the shoots of the internal branches were trained backwards from the original shoots, so that the central part of each tree was formed of fine bearing wood; and the size and general health of the trees afforded evidence of a more regular distribution of the sap than Mr. Knight had witnessed in any other mode of training.

It is remarked, that in this method of pruning little use was made of the knife during the winter; and Mr. Knight conceives that winter pruning should be avoided as much as possible, for the only advantage gained by laying in a larger quantity of wood in the summer and autumn, than will be wanted in the spring, is the choice of good shoots, and there is no real advantage in having more than are wanted; whereas the health of the tree always suffers by too much use of the knife through successive seasons.

As entering into the detail of pruning in the most advantageous manner would lead him beyond his intended limits, he merely avails himself of the opportunity to offer a few observations on the proper treatment of luxuriant shoots of the peach-tree, a subject not understood by either English or foreign writers on gardening.

Referring to a paper, communicated by him to the Royal Society, on the alburnum or sap of trees (which was noticed in this work at vol. iii. p. 124), he conceives that the facts detailed there afford sufficient evidence that the alburnum of trees becomes, during winter, a reservoir of the sap or blood of the tree, as the bulb of the hyacinth, tulip, and potatoe, certainly do of the sap or blood of those plants. Now a wall tree, from the advantageous position of its leaves, probably generates more sap than a standard tree of the same size, so that the gardener is compelled to destroy a large portion of the succulent shoots; the sap in consequence stagnates, and appears to choke the passages through the small branches, which consequently become incurably unhealthy and stunted in their growth, and nature affords means of relief by distributing the sap in the production of luxuriant shoots. These shoots all horticultural writers have directed to be shortened in summer, but Mr. Knight has found great advantages in leaving them unshortened, as they have uniformly produced the finest possible bearing wood for the succeeding year, and that the laterals from these shoots, if stopped at the first leaf, will often afford strong blossoms and fine fruit the succeeding season. He thinks that a luxuriant shoot should rarely or never be cut out or shortened, where space for training it can be found, but it should never be trained in a perpendicular position.

Observations.—The intimate knowledge which this writer possesses of the operations of nature in the vegetable creation, entitles all his suggestions on horticultural subjects to the greatest attention. The mode of pruning recommended in this paper, appears to possess all the advantages attributed to it, besides that of bringing a fruit-tree into a bearing state one or two years earlier than by the common method. For the propriety of the treatment recommended for the luxuriant shoots of the peach-tree we can offer our own experience for six or seven seasons, and the result has uniformly been, that the trees not only ceased to produce such shoots (whereas they had only been multiplied by amputation), but have continued to produce fine healthy bearing wood, and a profusion of blossom and fruit. As soon as any branch assumes a more luxuriant appearance than its neighbours, it should be trained, if possible, below the horizontal position.

CHEMISTRY AND MINERALOGY.

Chemical Analyses of Soils. By Mr. CADWALLADER BOYD.—*Bath Society's Papers, Vol. XI.*

IT is needless to notice any other particulars in this paper, but the results.

In each experiment 400 grains of the soils were used.

1. Chalk, from the neighbourhood of Marlborough, yielded 175.25 gr. of carbonic acid gas, 1 of silex, 4 of alumine and oxide of iron, 173.16 of lime, and 45.59 of water.

2. Compact blueish gray limestone with a coarse earthy fracture from Weston, called Somersetshire blue lyas, yielded 150.96 gr. of lime, 157.25 of carbonic acid gas, 32 of a residuum chiefly siliceous, with a small portion of bitumen, 6 of alumine with oxide of iron, and 53.79 of water and lost matters.

3. Bastard chalk, generally found under the writing chalk in Wiltshire, yielded 145.25 gr. of carbonic acid, 125.06 of lime, 7 of silex, 77 of alumine and oxide of iron, 5 of magnesia, and 40.69 of water.

4. Fuller's earth yielded 104 gr. of alumine and oxide of iron, 188 of silex, 64.75 of lime, and 43.25 of carbonic acid and water.

5. A bastard fuller's earth was found to contain silex in two states, as it yielded 96 gr. of fine silex, and 116 of coarse. This earth, treated with sulphuric acid, afforded nearly its own weight of good alum. For the use of clothiers, the coarse silex might be separated by washing over.

6. Granularly foliated gypsum, from London, yielded 144 gr. of lime, 168 of sulphuric acid, and 88 of water.

Four other specimens of gypsum, viz. grayish white granular gypsum partially striated from London, compact gypsum from Bristol, flesh-red compact gypsum from Derbyshire, and patent gypsum from London, yielded from 144 to 146 gr. of lime, 162 to 165 of sulphuric acid, 2 to 4 of magnesia and alumine, and constantly 88 of water.

The London Company's theory of gypsum as a manure is ingenious; but as gypsum must be ignited in contact with charcoal, in order to form a sulphuret of lime capable of dissolving charcoal, it does not appear how this is effected by its being sprinkled upon the ground.

7. The slags left in ancient smeltings of lead ore, treated with black flux, yielded from 72 to 108 gr. of lead; but this produce could not be realized in the large way. The silex which impeded the perfect fusion of the slag, might be separated by stamping and washing.

8. Productive soil from Ashley Barn, near Bristol, of the specific gravity of 1.696, yielded 52 gr. of water, 240 of siliceous

sand, 5 of vegetable fibres, 3 of vegetable extract, 48 of alumine, 2 of magnesia, 14 of oxide of iron, 30 of calcareous earth, and 6 gr. were lost.

9. Two specimens of soil from Cerney Farm, Gloucestershire, were examined. The productive specimen lost 26 gr. by drying at 300° Fahr. By the sieve it yielded 1 gr. of fibres, 137 of coarse stony particles, and 262 of fine. The fine part yielded 228 gr. of siliceous sand, 40 of finely divided matter washed over, 42 of alumine, 28 of carbonate of lime, 4 of sulphate of iron and animal matter, 1 of vegetable fibre, 22 of animal matter, 26 of water, and 9 gr. were lost.

The unproductive specimen lost 24 gr. by drying. By the sieve it yielded 2 gr. of fibres, 241 of coarse stony particles, and 157 of fine. The fine part yielded 232 gr. of siliceous sand, 32 of finely divided matter, 56 of alumine, 18 of carbonate of lime, 2 of sulphate of iron and animal matter, 2 of vegetable fibre, 26 of animal matter, 24 of water, and 8 gr. were lost.

10. Calcareous marle, from Cerney Farm, yielded 84 gr. of carbonic acid, 84 of silex, 80.66 of lime, 112 of alumine, and 39.34 of water.

11. Rough granular limestone, called coral rag, from Steeple Ashton, Wiltshire, yielded 184 gr. of carbonic acid, 8 of siliceous residuum, 18 of alumine with oxide of iron, 154.66 of lime, and 35.34 of water.

12. Rough granular limestone, called corn brash, from Woolveston, Wiltshire, yielded 170 gr. of carbonic acid, 16 of silex, 9 of alumine, 167.61 of lime, 1 of magnesia, and 36.39 of water.

13. Three specimens of limestone or bastard chalk, from Warminster, yielded from 160 or 180 gr. of carbonic acid, 10 to 60 of siliceous residuum, 2 of alumine, 160.05 to 191.40 of lime, and from 17.95 to 27.60 of water and lost matters.

Two specimens from Westbury, Wiltshire, yielded from 127—130 gr. of carbonic acid, 116—126 of siliceous residuum, 12—14 of alumine, 115.50—111.10 of lime, and 29.5—18.9 of water and lost matters.

14. Corston soil, of the specific gravity of 2.206, yielded 26 of water, 66 of stony matter, partly siliceous partly aluminous, 254 of coarse siliceous sand, 10 of fine sand, 6 of carbonate of lime, 4 of animal matter, partly decomposed, 16 of alumine and oxide of iron, 3 of sulphate of potash and vegetable extract, 1 of vegetable fibre, and 14 gr. were lost.

Observations.—These analyses, like many others made by mere chemists, afford very little information, because the description of the substances is omitted. It cannot be too strongly pressed upon the notice of mineralists and chemists, that the union of the two sciences is absolutely necessary to the perfection of either.

On the Ignition of Tinder by compressed Air. By Mr. T. Clifton. —*Phil. Journ. No.* 89.

The ignition of tinder, and of different species of *fungi*, by the quick compression of air in a small condensing syringe, merits consideration, whether it is to be ascribed to the mechanical action of the air, or to a change of capacity induced by its rapid condensation.

The editor of the Journal imagines it is produced by the latter mode. Dalton's experiments shew that the pressure of the atmosphere induces an increased temperature of 50°; and hence, if the augmentation is in the simple ratio of the condensation, a compression of 18 atmospheres would give the temperature of ignition.

Observations.—In the following paper, Mr. Accum expressly considers the query proposed by Mr. Clifton.

A patent has been taken out by Mr. Lorentz, for producing light and fire, in which he employs, as one of his methods, the compression of the air, by means of an elegant but costly apparatus, described in vol. iii. p. 374, of this work.

On the instantaneous Production of Fire, by the mere Compression of atmospheric Air. By Mr. Frederic Accum.—*Phil. Mag. No.* 122.

The discovery of the accension of combustible substances by the rapid compression of atmospheric air, was made by Mollet. The evolution of light in this condensation seems to have been first noticed by a workman at St. Etienne, who in discharging an air-gun highly loaded, observed a vivid flash at the orifice of the barrel.

The instrument usually sold for this purpose, consists of a common syringe, about 10 in. long and not more than 5-8ths in. bore. At the lower extremity a chamber to contain the substance intended to be fired is attached by means of a screw.

The accension of combustible bodies by this mode is not owing to the condensation of the air, and consequent sudden liberation of caloric; but to the intense and rapid mechanical motion and vibration produced in the particles of the body placed in the chamber of the instrument. Neither phosphorus, phosphuret of sulphur, camphor, ether, naphtha, fulminating gold, fulminating quicksilver, or other substances which readily take fire, can be inflamed by the compression of the air, nor can the fusible alloy be melted in this manner. But porous or fibrous matters are in-

stantly inflamed, as common tinder, amadou, very dry tow rolled up in a coil, common touchwood, the scrapings of dry paper or linen rag.

Biot affirms that the mixture of hydrogen and oxygen may be inflamed by sudden compression. Great danger must attend the verification of this singular experiment.

On the Purification of Lemon-juice.—Phil. Journ. No. 90.

ADD one dram of nitro-muriate of tin, made by dissolving tin in a mixture of two parts of nitric acid with one of muriatic acid, to a quart of lemon-juice. Let it stand forty-eight hours and then filter it. Some of the nitro-muriate may perhaps remain in solution, and therefore the following method seems preferable.

Add an ounce of pulverized well-burned charcoal to a quart of lemon-juice, and after standing twelve hours filter the juice through white paper.

Observation.—There can hardly be any doubt but that the latter mode is by much the best.

On the Effects of Galvanism on Animals. By Mr. JOHN TATUM. *—Phil. Journ. No. 90.*

A FROG killed by immersion in carbonic acid gas did not afford any muscular contractions by the action of a galvanic trough of 350 inches, in 50 plates, neither in the inferior nor superior extremities.

Another frog, killed by electricity, was not excited by the same galvanic power; nor was any contraction produced when the same frog was afterwards moistened with oxygenized muriatic acid: but at the expiration of six hours, the head of the moistened frog appeared more healthy than when it was left, and convulsions were produced by a single pair of zinc and silver plates, of $1\frac{1}{2}$ inch diameter.

A mouse, killed by dividing the vertebræ of the neck, was strongly excited by 60 pairs of copper and zinc plates; but the same plates had scarcely any effect on another mouse, killed by being confined in atmospheric air.

The wires from four troughs of 106 pair of plates, containing 5360 in. surface being placed in a jar of water, in which were two large frogs, instantly affected them so severely, that they appeared very languid the next day, and, on the second, died.

Hence animals seem to possess a certain portion of excitability in proportion to the oxygen they contain, which by galvanism and electricity produces muscular motions, both in the living and dead

animal; but if too great a portion of these be applied, it finally exhausts the excitability, and produces death. The excitability may also be destroyed, by depriving the animal of those things that are calculated to increase, or replenish it; and animals deprived of life by this latter mode cannot be subsequently excited by the most powerful stimuli.

Thus the frogs killed by electricity or deprivation of oxygen could not be excited; but the excitability was in some measure restored by the absorption of oxygen from the oxygenized muriatic acid, or the atmosphere.

On the apparent Radiation and Reflection of Cold by means of two concave metallic Mirrors. By Mr. John Martin.—*Phil. Journ. No.* 90.

The apparent radiation and reflection of cold is one of the many chemical facts which are not so well understood as the present state of science might lead one to expect. It has been supposed that the thermometer placed in the focus of one mirror acts as an heated body, and that the heat radiating from it is transmitted to the cold body in the opposite focus; but as the thermometer is not hotter than the atmosphere, it cannot radiate caloric; nor does it appear how it can be reduced to a temperature lower than that of the surrounding atmosphere.

The following seems to be a clearer explanation of it than the former:

There are two ways by which heat can be made to move in one direction through a given body. A superior temperature may, for example, be applied to a wire A B, at one end of it B, and thus cause the heat to move on towards A by the conducting power of the wire, and the tendency of the caloric to establish an equilibrium; or the temperature of the other end A may be lowered, and the vacuity of heat thus formed filled up by the abstraction of heat in the direction from A to B.

If then a cold body be brought near a plane reflecting surface, some particles of heat will of course enter into it from the reflecting plane, and thus a vacuity of heat being formed, particles of heat will strike on every part of the plane in such directions as to be thrown off in right lines to the cool body: consequently substituting concave reflecting surfaces for plane ones, the heat enters into the cold body placed in the focus of one mirror in all directions, and of course the mirror becomes cooled, and can only receive a fresh supply of heat in parallel rays in a direct course from the opposite mirror, because only such rays can be thrown off towards the cold body. This causes the opposite mirror to become cool, and to be supplied with heat from the thermometer placed in the focus, which consequently must become cooler than a body placed any where in its neighbourhood.

On the late Discovery of Metals in the fixed Alkalies.—Phil. Journ. No. 91.

Dr. Beddoes noticed the existence of oxygen in the alkalies and earths, and also advised the application of the strongest electrical shocks to molten phosphorus in his lectures at Oxford in 1788. In his "Contributions" a query is started, whether the alkalies and earths do not hold oxygen, and ought not to be classed with the metals.

The editor of the Journal remarks, that metals far different from the metallic bases of the alkalies as exhibited by Mr. Davy, and resembling iron, or phosphuret of iron, were apparently produced by Ruprecht and Tondi from barytes, lime, magnesia, and borax; but this reduction was supposed to be fallacious, because similar metals were obtained without either of these substances, although in this case it would appear that an alkali was always present.

On the Decomposition of the Alkalies. By Mr. William Cooke. *—Phil. Journ. No. 91.*

No want of accuracy can be ascribed to the experiments of Mr. Davy; but the conclusions drawn from them do not seem to be clearly accounted for.

Mr. Davy, by exposing *moistened* potash in a galvanic circle, obtained a metallic substance, oxygen being evolved during the operation. The metal itself instantly decomposes water, alkali is reproduced, and hydrogen evolved.

The matter of electricity seems to combine with other matter in the same manner as caloric or light does. The concentrated sulphuric acid cannot be formed without the union of caloric, nor diluted without the loss of it, and may therefore be considered as a *calorated oxygate of sulphur*. The new metals may be called electrated hydrates of potash, soda, &c. which are decomposed by water, the matter of electricity becoming visible, the hydrogen being evolved, and the alkali remaining in solution.

Mr. Davy seems to have overlooked the importance of accounting for the whole of the ingredients submitted to experiment. As the alkali was moistened, and one of the component parts of water was evolved, it was necessary to inquire what became of the other, especially as the product was incompatible with the existence of water.

The new substances, instead of being the basis of the alkalies, seem to be compounds of alkali and hydrogen united by means of the electric fluid.

Observations.—These remarks seem to have been written before the actual appearance of Mr. Davy's paper, as they take no notice of his synthetic determination of the quantity of oxygen absorbed by these new metals. These experiments were, indeed, made on such small quantities, that much dependence cannot be placed on them; but at the same time a great degree of verisimilitude attaches to them; and therefore, although Mr. Davy's own explanation of these experiments is not so certain but that it may be false, it bears a greater appearance of truth than the explanation of Mr. Cooke.

On the Quantity of Fecula in different Varieties of the Potatoe. By Mr. William Skrimshire, *Jun.—Phil. Journ. No.* 91.

Dr. Pearson (Repert. Arts, III. p. 383) found that 3500 grains of the white kidney potatoe root left on drying 1000 gr. The fresh root deprived of its skin contained 68 to 72 per cent. of water, and 32 to 28 of meal, consisting of from 17 to 15 of fecula, 9 to 8 of fibrous matter, and 6 to 5 of extract or soluble mucilage.

The potatoe called Captain Hart is white, with a thin smooth skin, roundish, of a moderate size, with few eyes. When boiled it is yellow, rather close and watery, but tolerably well flavoured. It weighs 14 to 15 lb. a peck: 5 lb. of it yielded 9 oz. of white fecula, 3 of slightly discoloured fecula, and 6 of dried pulp; the remainder being water, soluble mucilage, and extractive matter.

The rough red has a thin rough skin, and is of a moderate size. When boiled it is very mealy, but has a strong taste. It weighs 13 to 14 lb. a peck: 5 lb. of it yielded 7 1-4th oz. of white fecula, 3 1-4 of discoloured fecula, and 6 1-half of dried pulp.

The white kidney is white, with a thick skin: it is of a tolerable size, and variously shaped. When boiled it is not very mealy, but pleasantly flavoured. It weighs from 14 to 15 lb. a peck: 5 lb. of it yielded 9 1-half oz. of indifferent coloured fecula, the potatoes examined having vegetated, and 3 3-4ths of dried pulp.

The Moulton white has a thick skin: it is of a tolerable size, and resembles the white kidney potatoe in form. When boiled it is mealy, and remarkably well tasted, so that it is by far the best for the table. It weighs about 16 lb. a peck: 5 lb. yielded 9 oz. of white fecula, 2 3-4ths of discoloured fecula, and 5 3-4ths of dried pulp.

The Yorkshire kidney is white, with a thick skin: it is thin and long, with several eyes, and very scabby. When boiled it is mealy, but has a strong taste. It weighs 14 to 15 lb. a peck: 5 lb. yielded 8 3-4ths of white fecula, 2 1-half of discoloured fecula, and 6 1-half of dried pulp.

The hundred eyes is white, with numerous eyes, and a depression below each eye: it is of a middling size and long. When boiled it is very close, but its taste is not unpleasant. It weighs from 14 to 15 lb. a peck: 5 lb. yielded 8 1-4th oz. of white fecula, 3-4th oz. of discoloured fecula, and 6 3-4ths of dried pulp.

The poor man's profit, or purple red, has a thin skin: it is large and round. When boiled it is hard and close; its taste is not very unpleasant. It weighs from 15 to 16 lb. a peck: 5 lb. yielded 8 oz. of white fecula, half oz. of very brown fecula, and 5 oz. of dried pulp.

The ox noble is white: it is very large and round, but is frequently hollow. When boiled it is close and watery, with a strong taste, so that it is mostly used for feeding cattle. If sound it weighs from 15 to 16 lb. a peck: 5 lb. yielded 6 1-half oz. of white fecula, 1 3-4ths of discoloured fecula, and 8 of dried pulp.

On the Identity of Silex and Oxygen. By Mr. Joseph Hume.—*Phil. Mag. Nos.* 118, 119, 120, *and* 123.

It is obvious that a most material revolution is now dawning upon the modern system of chemistry, and it is probable that an entirely new theory must eventually be formed. The word oxygen in particular stands as a solecism in nomenclature, since it is not only the principle of acidity, but likewise of alkalescence.

Many of the subdivisions of elementary bodies might with propriety be expunged; and silex is very improperly ranked with the other earths, notwithstanding they are said to be salifiable bases, as silex is never found in any true saline combination. There are only some salts, in which it exists as a mere contingency.

Silex, or what may be considered equivalent to it, namely, oxygen, is predominant, and universally disseminated in nature. All organized bodies contain it, and there is no compound solid substance of any magnitude in which it is not found. There is nothing in nature to which silex bears any resemblance but oxygen gas, of which it appears to be the true base; for oxygen gas itself is not a simple body, as it is susceptible of a spontaneous change, or deterioration, as it was called by Messrs. Allen and Pepys in their experiments upon carbone and carbonic acid, related in our last vol. p. 532.

Mr. H. states, that he is the person to whom the opinion respecting the identity of silex and oxygen, as stated in the Chemical Catechism, belongs.

In the atmosphere, oxygen saturated with caloric forms the principal element, and composes a fluid that might be better styled phlogiston than oxygen gas, as more aptly suiting the properties of

pure air. In the aqueous portion of the terraqueous globe, oxygen forms nearly 4-5ths of its magnitude : we may therefore expect it to form the most conspicuous ingredient in the solid portion of the globe ; and indeed silex, or some acid, which of course contains oxygen, is united with almost every mineral.

After silex, there is no substance so plentiful as lime, and this, even when pure, appears to be a compound : it is, however, a decided salifiable base, and is probably produced by means of the degradation of silex. It has been supposed by some persons that a contrary process took place, and that the carbonate of lime was graduated into silex ; but in this case we should be obliged to suppose that all the several constituent parts of carbonate of lime, viz. diamond, oxygen, and lime, contribute to the formation of silex.

Silex is found plentifully united with chalk, either intimately blended with that carbonate, or in the form of flint stones. These stones are always found in rounded nodules, and therefore seem to have suffered a diminution of their original bulk. They are also encrusted with a white opake crust, which appears to be the commencement of the new modification assumed by silex.

The title of alumine to be esteemed a primitive earth is questionable, especially as it has a very peculiar smell.

In ores, consisting of lime, silex, and metal, as in that of titanium, the silex seems to be the cause both of the insipidity of the lime, and the oxidized condition of the metal. In some ores it seems as if nearly the whole of the silex had been expended in oxidizing the metal. Galena is frequently accompanied with silex, and the general neutrality of the whole may be ascribed to this earth.

Magnesia is always found either blended with an acid, or concealed by means of silex, by which it is deprived of its qualities.

Potash and soda are found as principal constituent parts of various mineral bodies, and furnish conclusive examples of the neutralizing and oxygenating power of silex, by which they are reduced into one mass of tasteless stone.

The meteoric stones contain about half their weight of silex ; and as these are strongly suspected of having been ejected from some volcano in the moon, they shew that substances, which are apparently independent of our globe, are also chiefly formed of silex.

Iron is one of the most constant associates of silex, and is always oxidized. Though iron is considered as a simple substance, yet it may be doubted whether it has ever been obtained free from carbone, phosphorus, or silex. Some of these impurities seem, indeed, to render the metal more perfect, for the carbone and silex in good steel are to be considered as improving the iron. Vauquelin found that the hydrogen evolved during the solution of iron in acids was impure ; and indeed as all bodies that have a smell are

probably impure, even the hydrogen that is obtained by the decomposition of water by the metals is impure; and hence the elementary nature of hydrogen itself is doubtful.

The nature of fluoric acid, and its action on silex, is still clouded with inconsistency and ambiguity. The native fluate of lime is so very generally contaminated with silex that it is probable no fluoric acid exists without it, and the acid may owe its origin to silex. No notice has been taken of the oxide of lead, and the subsequent disposition of the whole of the ingredients when glass is corroded by fluoric acid.

There is a remarkable similitude in the effects of oxygen and silex on the metals. By means of either of these saturating bodies, the metals, although the most opake bodies in the universe, may be rendered quite pellucid, and afford examples of the most beautiful colours.

All the potash of commerce contains silex, and retains it not as an adventitious ingredient, but rather as the surcharge of what is essentially necessary to its existence as potash, especially as the primitive seat of potash is in rocks and stones, where the atmosphere can have had no influence. The action of silex upon potash, soda, and the other ingredients of glasses, are instances of its neutralizing power. An effervescence takes place when the sand and alkali enter into fusion, and therefore as something is apparently evolved, neither oxygen nor any other aëriform fluid can be supposed to enter into the glass; the acidity, as we may call it, that coerces the alkaline matter, is, in fact, due to the silex: indeed vitrification in general seems to be accomplished either by silex or oxyen.

In natural hot springs, silex seems to be deposited, and deprived of the caloric which had suspended it in the form of gaseous oxygen. It may be questioned, whether the nitrogen in the Bath waters, and probably in other hot springs, is not the residuum of decomposed atmospheric air, the oxygen of which is deposited in the form of silex

Some acknowledged acids are insipid, and therefore silex may be an acid although it is not sour. It has been lately observed in the Journal des Mines, xx. 245, that "in the analysis of ores silex acts very sensibly as an acid."

Silex is contained in several mineral waters, in which it cannot be supposed to be held in solution by an alkali, because either an alkali is not present, or the alkali is combined with carbonic acid. The same waters frequently contain carbonate of lime, and they seem to shew the graduation of silex into lime. This conversion, if true, must be effected at some depth beneath the surface.

Few substances are so rare as pure carbone, or the diamond, and yet in combination with other elements, especially with silex or oxygen, what can be more copiously and universally diffused through every species of matter?

The diamond is usually found in siliceous materials, or ferruginous sands: although supposed to be pure carbone, its powder is always white and like powdered glass, whereas charcoal powder is always black, a circumstance which militates against the supposed identity of these substances.

The peculiar smell evolved by siliceous stones, when they are made to yield sparks by percussion, is precisely the same as that which succeeds the electrical excitation, or the strong effects of lightning: and thus silex is assimilated in one quality at least, with one of the most important objects in nature, viz. the atmospheric electric fluid.

That silex is transmuted into other substances, may be inferred from several phenomena. After the formation of chalk from silex, the next advance is most probably into clay, because in all chalky soils the superficial stratum is clay, which always contains a considerable quantity of silex in the form of sand.

Silex is not confined to unorganized matter, but also pervades the structure of all organized beings. In vegetables it is principally found in the epidermis and other external parts; and it is not a little remarkable that common charcoal, with the bark attached to it, affords a more brilliant light, when burned in oxygen gas, than if the bark was wanting: and this combustion is peculiarly brilliant when bamboo charcoal is employed, which is well known to abound in silex.

Although clay is comparatively a very soluble and tractable substance, it is never found in organized bodies; and as the silex seems always to be found in conjunction with potash, it is probable that one is subservient to the production of the other; and it is far more likely that the alkali is produced from the silex than the contrary.

Ancient and modern experiments shew, that vegetables may be cultivated by the help of water alone. Various objections have been made to Braconnot's experiments; but they amount only to a denial of the facts, or to captious objections built upon unfair premises.

Contrary to a very generally adopted theory, it appears that plants do not emit oxygen gas, that nitrogen is not necessary to their growth, that the presence or absence of carbonic acid has no effect upon the growth of plants, and that oxygen is not only necessary to the vegetative process, but that it is converted into carbonic acid without entering into the vegetable system. As plants constantly produce carbonic acid, it seems absurd to suppose that they absorb it: for as Mr. Ellis says, where is there an instance, in the whole circle of existence, of a living agent forming its own food, and feeding upon its own excretions?

It is very difficult to account for the circulation and accumulation of insoluble substances in particular receptacles in vegetables, more especially as they are frequently deposited in the most dis-

tant extremities, and must sometimes have passed through ways in which substances capable of decomposing them are lodged.

Silex does not seem to be a mere accidental material in animal bodies, but essentially necessary to the life of such animals. It is contained in human hair, and probably in the other animal coverings, as scales, quills, feathers, wool, &c. Silex undoubtedly forms a part of the food, and also of the excrements of animals; which excretions are always of an acid nature. It is, perhaps, on account of the large quantity of silex that it contains that pigeons' dung has been found an excellent manure for vines.

The gastric juice of animals in general is of an acid nature, which probably arises from the silex found in the stomach. In effect, there is usually a large quantity of siliceous stones in the gizzards of birds. The whole contents of the gizzard of a goose were pure siliceous matter, insoluble in dilute muriatic acid, and the stones when collected together exceeded 1 oz. in weight. The gizzards are sometimes quite empty, and at other times completely crammed. It is absurd to suppose these stones are for the purpose of grinding the food.

In an experiment purposely made by Vauquelin, he found that when hens were fed with oats, there was less silex in the excrements than was contained in the oats; and on the other hand, that there was found an excess of lime, partly combined with phosphoric acid, and partly with carbonic acid, above what was contained in the food; so that, by the digestive power of the hen, silex was converted into lime.

Some dependence is here placed upon geological proofs, although there is no science in which speculation and hypothetical reasoning have been more freely indulged, and the most opposite, and even extravagant theories defended, than in geology. This science is, indeed, in its infancy, as the depth of the crust of the earth, which man has hitherto penetrated, is but a very minute portion of the diameter of the earth. In this paucity of information, as no theory should be implicity accepted, so none should be hastily condemned or refused without a candid investigation.

Observations.—We have here attempted to give some idea of Mr. Hume's proofs of his hypothesis that silex is solidified oxygen; a task which has required a considerable degree of labour on account of the extreme verbosity of the original. As to the merits of the hypothesis itself, we freely confess ourselves to be entirely hostile to it; nor do we think that it requires any refutation, as its absurdity seems self-evident. A Mr. Heron published some years ago a book, in which he laboured to prove that lime was solid oxygen: no one chemist since his time seems to have bestowed the least attention on this proposition; nor do we think that Mr. H. will be much more successful in procuring followers, although

Mr. Parkes in his Chemical Catechism, and Mr. Farey in a paper on the Derbyshire strata, published in the Philosophical Magazine, have expressed a favourable opinion of this strange hypothesis.

On the Light emitted by Silver in a State of Combustion. By Mr. G. J. Singer.—*Phil. Mag. No.* 121.

When the deflagration of the metals by the Voltaic battery was first published, it was observed that silver burned with a bright emerald green light; but when the experiment was repeated at the Royal Institution, the deflagration of the silver was attended with a brilliant white light, which Mr. Davy ascribed to the great purity of the silver; and he thought that the green flame arose from the copper frequently mixed with the former metal. But this explanation is not true, as by the application of a piece of charcoal to the ends of the conducting wires, so that either the wire itself or the charcoal may be made to touch the silver at pleasure, the white and green flame may be alternately produced: so that it is evident that the white light proceeds from the charcoal, with which Mr. Davy's wires were terminated.

On the Union of Gases. By James Scholes—*Phil. Mag. No.* 121.

In Mr. Dalton's new treatise on chemical philosophy, he assumes, that two gases, each pressing on the containing vessel with a force equal to unity from each particle; and having no repulsive action on each other, the joint effect of this pressure will be equal to the individual effect of a single gas, with a similar pressure of 1.26. But as the two gases cannot, on the principle assumed, occupy more space than each would individually, and as the repulsive power of gases under the same circumstances, is as the space occupied by them; consequently the powers of expansion in two gases, with no repulsive action on each other, cannot act conjointly, but must be equal only to the expansion of a single gas; whose power is as great as either of these supposed conjoined forces. Again, as action and reaction are always equal, and the two gases have by assumption, nothing to react upon but particles of their own species, how can the pressure upon the vessel be as 1.26 for each particle of gas, while the utmost reaction of each particle is only equal to unity?

A mechanical theory of the union of gases, which will bear mathematical demonstration, and will apply to every phenomenon, may be formed by assuming from the law of elastic fluids this principle, that if the repulsive sphere of one gas be greater than

the repulsive sphere of the other, the particles of any two or more elastic fluids will arrange themselves at the greatest possible distance from each other.

On chemical Nomenclature.—Phil. Mag. No. 121.

The names of metallic salts ought to shew in the most concise manner, the acid, the oxide, and whether it is neutral, or contains an excess of acid or of base.

The difference between the present nomenclature, that proposed in the Phil. Mag. for May 1808 (see our last Number, p. 192), and an improvement of the last system, will be evident from the following comparative table, which exhibits most of the absurdities of the present nomenclature.

Sulphate of mercury—sulphated protoxide of m.—prosulphat of m.

Supersulphate of m.—supersulphated protoxide of m.—superprosulphat of m.

Subsulphate of m.—subsulphated protoxide of m.—subprosulphat of m.

Oxysulphate of m.—sulphated peroxide of m.—persulphat of m.

Superoxysulphate of m.—supersulphated peroxide of m.—superpersulphat of m.

Suboxysulphate of m.—subsulphated peroxide of m.—subpersulphat of m.

Hyperoxymuriate of m.—oxymuriated peroxide of m.—peroxymuriat of m.

Muriate of m.—muriated protoxide of m.—promuriat of m.

Oxymuriate of m.—muriated peroxide of m.—permuriat of m.

Nitrate of lead—nitrated protoxide of lead—pronitrat of lead.

Oxynitrate of lead—nitrated deutoxide of lead—deunitrat of lead.

Observations.—On these last series of names it may be remarked in general, that to change the name expressive of the acid, in order to denote a difference in the base, does not seem consonant to the universal rules which ought to be adhered to in forming new names.

The communication is dated from London, but how the ear of any person resident in the metropolis, could allow him to accede to the cacophony of the final t's adopted from the French, by bald translators in the distant provinces, for expressing the names of the acids, is truly surprising.

We have already, in our observations respecting a former paper

on the same subject, given our objections to expressing the differences of the oxides of the same metal by the numerical order of the degree of their oxygenizement.

The excessive inconsistency of the equivocal terms already introduced, as arsenic, cobalt, manganese, antimony, potash, soda, ammonia, magnesia, &c. does not seem to be duly appreciated by the author, perhaps because he reads only in one book, since he proposes to increase their number by adding borax, fluor, and nitre to the list, and also muria, if the Latin language be employed.

Hints respecting Women's and Children's Clothes catching Fire.—Phil. Mag. No. 122.

To prevent the clothes from catching fire, it is necessary to have fenders of wire-work projecting into the room, sufficiently open to let the heat through, but not the coals.

To check the progress of the flames, a green baize cloth might be constantly laid *loose* upon the tables or other pieces of furniture in rooms where any danger of fire is to be apprehended. If this cloth was known in the family by the name of the stifling cloth, it would probably be as readily used when there was occasion for it as fire-engines or buckets now are. A cloth coat, or a blanket, will answer the same purpose.

It should be explained to females and children, that as flame always flies upwards; if they continue in an upright posture, the fire has a greater power, and the neck and head run a great chance of being hurt. It is, therefore, better to throw themselves upon the ground, and roll themselves on their clothes, which will retard the progress of the fire.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

A mathematical Problem. By JOHN GOUGH, *Esq.—Phil. Journ. No. 91.*

THE problem is, "to a given arc of a circle a, let it be required to add another z, making the sum of the two arcs equal to the tangent t of the latter, viz. $a + z = t$."

Mr. Gough first shews, by a fluxionary process, that the problem contains nothing absurd. He then states the geometrical form of the problem, which is, to find a point in a tangent drawn from a given point, from which former point if a line be drawn to the centre of the circle, there shall be included between the tangent, the last drawn line, and the circumference of the circle, a space equal to a given circular sector. He next remarks that

the problem is impossible, unless a be a finite magnitude: but is possible in all other cases, whether n the number of quadrantal arcs (Q) in a be even or odd, integral or fractional. Mr. Gough then enters upon the analytical solution, and finds various serieses for the determination of z, according to the different values of a. Some of these serieses, however, are not very tractable; but they converge with sufficient rapidity to give the value of z, moderately correct, in the several cases to which they are applied. Thus, when $n = 9$, or $a = 9$ Q, then $z = 86° 20' 37''$ nearly: when $n = 100$ or $a = 100$ Q, $z = 89° 57' 48''$; when $n = .009$, or $a = .009$ Q, $z = .2964157$.

Observations.—This ingenious geometer has succeeded very well in the solution of the problem before us: but has failed entirely in his animadversions upon Euler, the mathematician to whom he alludes in the course of his investigation. The problem considered by Euler in his *Analysis Infinitorum*, quoted by Mr. Gough, is "Invenire omnes arcus, qui tangentibus suis sint æquales," i. e. *To find all those arcs* (meaning in the same circle), *whose tangents are equal to them:* a problem which has recently been considered in the *Gentleman's Diaries*, for 1807 and 1808. Euler finds, by a series, arcs in the 3d, 5th, 7th, &c. quadrants, reckoning from any assumed point, equal to their respective tangents drawn *from the same point:* but he does not attempt to find arcs in the 2d, 4th, and other even quadrants, because the tangents to arcs in such quadrants drawn from the same commencing point run in a contrary direction to the former; and are, therefore, accounted *negative*. Mr. Gough endeavours to invalidate this reasoning by means of a diagram in which tangents are drawn from two different extremities of a quadrant, and says, that because these tangents are at right angles to each other, the relations of *plus* and *minus* do not apply to them: be it so; but let it at the same time be remembered, that, in this his elucidation, tangents are drawn from two *different* points; whereas, both in his own problem and that of Euler, the tangents must all *commence at the same point*. But there needed not this solicitude to refute Euler. The problem in the Analysis Infinitorum, and that proposed by Mr. Gough, are *perfectly distinct:* Euler's is necessarily limited to the odd quadrants, by the agreed definitions of terms, for the reason he assigns: while Mr. Gough's manifestly applies to all cases where n is a finite number; because tangents drawn from the same point to arcs in the first quadrant allow of all values between nothing and infinity; and, of consequence, a tangent may be determined equal to any number of quadrantal arcs we please *plus* the arc to which such tangent belongs.

On a new Property of the Tangents of the three Angles of a plane Triangle. By Mr. WILLIAM GARRARD, *Quarter-master of Instruction at the Royal Asylum at Greenwich.—Phil. Transac.* 1808, *Part I.*

On a new Property of the Tangents of three Arches, trisecting the Circumference of a Circle. By NEVIL MASKELYNE, *D. D. F. R. S., and Astronomer Royal.—Phil. Transac.* 1808, *Part I.*

THE property mentioned in Mr. Garrard's paper is, that the sum of the tangents of the angles of a plane triangle, multiplied by the square of the radius, is equal to the continued product of these tangents. This Mr. G. demonstrates, in two cases; one applying to the case of acute-angled, the other to that of obtuse-angled, plane triangles.

The property mentioned by Dr. Maskelyne, is an obvious extension of Mr. Garrard's; being this: *The sum of the tangents of three arches any way trisecting a circle, multiplied by the square of the radius, is equal to the product of these tangents.* The Doctor's demonstration of this theorem, freed from an inadvertency into which that distinguished astronomer has fallen, is as follows.

We premise, as well-known truths, that the tangent of any arch and of its supplement to the whole circumference, or 360°, are equal in magnitude; but in the relation of positive and negative: and that, of two arcs A and B we have, $tan.\ (A + B) = \frac{r^2 \times (tan.\ A \times tan.\ B)}{r^2 - tan.\ A.\ tan.\ B}$, r representing the radius of the circle to which the tangents appertain. Then, the three arcs being A, B, and C, whose sum makes up the whole circumference $\odot$; we have $r^2 \times (tan.\ A + tan.\ B \times tan.\ C) = r^2 \times (tan.\ A + tan.\ B - tan.\ (A + B) = r^2 \times (tan.\ A + tan.\ B - \frac{r^2 \times (tan.\ A + tan.\ B)}{r^2 - tan.\ A.\ tan.\ B} =$ by actual multiplication and reduction, to $tan.\ A \times tan.\ B \times - \frac{r^2 \times (tan.\ A + tan.\ B)}{r^2 - tan.\ A.\ tan.\ B} = tan.\ A \times tan.\ B \times tan.\ C$, since $tan.\ C = - tan.\ (A + B) = - \frac{r^2 \times (tan.\ A + tan.\ B)}{r^2 - tan.\ A.\ tan.\ B}$, by what has preceded.

Observations.—We are rather surprised that the Astronomer Royal should be so imposed upon, as to communicate Mr. Garrard's property of tangents to the Royal Society, as a new one. Even with Dr. M.'s modification of it, it is too trifling, as will be manifest to every mathematician, to deserve a place in the Philosophical Transactions. But, in the shape Mr. Garrard presents it

to the public, it has been well known for nearly half a century; and was indeed proposed *nineteen* years ago by this identical Mr. William Garrard in a periodical publication called *The Scientific Receptacle*, sold by Longman. It would seem that, at that period, Mr. G. had found out the property *by trials*, and was not able to demonstrate it, simple as it is: for, though the Scientific Receptacle contains *four* demonstrations, not *one* of them is by the proposer of the thorem. After an interval of nineteen years, however, this "Quarter-master of Instruction" contrives to manufacture a demonstration rather different from any which had been previously published; and, through the kindness of Dr. Maskelyne, is enabled to foist the property upon the public *as new*. But Mr. G. may learn from this exposure, that, though an individual may be deceived, the public will not.

An Essay on polygonal Numbers, containing the Demonstration of a Proposition respecting whole Numbers in general. By John Gough, *Esq.—Phil. Journ. No.* 88.

The proposition which Mr. Gough proposes to demonstrate, was first made known more than a century ago, in a work entitled "Diophanti Alexandrini Arithmeticorum lib. 6, cum Comm. C. G. Bacheti," by M. de Fermat, an eminent French mathematician of that time. He said he was *able* to demonstrate the following general and curious properties of whole numbers, viz.

That every number is either triangular, or composed of two, or three triangular numbers:

That every number is either square, or composed of two, or three, or four square numbers:

That every number is either pentagonal, or composed of two, or three, or four, or five pentagonal numbers. Or, adopting the general enunciation of Mr. Gough, that, "every whole number is either a polygonal number of a given denomination m; or, it may be divided into polygons of that denomination, the number of which does not exceed m."

M. de Fermat, *if* he were able to demonstrate this singular property of numbers, never published his demonstration: and we believe no demonstration has ever been published, except in the case of squares, by M. Legendre in his *Théorie des Nombres*. We are sorry to say that Mr. Gough's attempt at a demonstration of the general proposition is, in our estimation, unsatisfactory.

Essay upon Machines in general. By M. Carnot, *Member of the French Institute, &c. &c.—Phil. Mag.*

We notice briefly this article, which is publishing by portions in the Philosophical Magazine, because some of our readers are surprised that we have not noticed it before. We are equally

surprised that this essay should have found its way into the Philosophical Magazine at all. The name of the distinguished author would invite a respectful attention to any *new* work of his production: but the fact is, that the piece thus translating and publishing in England appeared in France so long ago as the year 1783; but that M. Carnot has, since that period, by abandoning some of his principles, modifying others, and expanding others, formed a completely new work of more than double the size of the original, and under a fresh title; namely, *Principes fondamentaux de l'Equilibre et du Mouvement*, Paris, 1803. A person must, we should suppose, presume much upon the ignorance of our mathematicians of what is doing on the continent, who can *favour* them with a translation of an old and rejected edition of a performance, of which an edition with the author's latest improvements is, or may be, in every person's hands. We have only to add that the translation often appears loose, and exhibits indications of being executed by one who does not understand the subject. *Mouvement*, for example, is translated *movement* when it means *motion*. Motion in a watch is very different from its movements. Again, *forces vives* is translated *active* forces; as if the translator had never heard of the celebrated controversy respecting the *vires vivæ et mortuæ*, or the *living* and *dead* forces. In the fluential expressions, too, the short *s* is used instead of the long *f*, generally employed to denote such quantities.

On the Planet Vesta. By S. Groombridge, *Esq.*—*Phil. Mag. No.* 123.

Mr. Groombridge gives in this paper a concise account of his observations upon this new planet, from April 26, 1807, when he first observed it, to Aug. 21, 1808. From the following places, as observed upon the meridian, the planet's course may be traced:

1808. Aug.	Mean Time. h. m. s.	App. R. A.	Dec. S.	Long.	Lat. S.
11.	14 24 32	356° 30′ 2″	12° 0′ 40″	351° 58′ 35″	9° 37′ 15″
14.	14 11 20	356 8 51	12 23 44	351 29 56	9 50 1
19.	13 48 50	355 25 27	13 3 40	350 34 51	10 9 22
21.	13 39 40	355 6 14	13 20 2	350 9 42	10 16 44

Mr. Groombridge finds that the opposition would happen about September 9. Part of the elements, according to his computation, are as below:

Inclination of the orbit.....	7° 8′ 20″
Ascending node.....	104 38
Period.....	3.182 years
Mean radius of orbit.....	2.163

The eccentricity appears considerable; but Mr. G. has not yet appreciated its quantity exactly.

Observations.—For other remarks relative to this celestial body, our readers may turn to pp. 477, 481 of our 11th Number. We have only to add here, that the inclination of this planet's orbit is less than that of any of the other planets discovered during the present century: that of Ceres being 10°6167, of Pallas 33°75, and of Juno 21°. Its mean distance from the sun is also less: that of Ceres being 2.7767, of Pallas 2.7769, and of Juno 2.8767.

Description of an Improvement on Tide-mills, to make them work as well at high and low Water as any other Time of Tide. By Mr. John Isaac Hawkins.—*Rep. of Arts, No. 76, Second Series.*

Mr. Hawkins's improvement consists in having a reservoir to be filled by the tide at high water, through a canal furnished with a valve-sluice, so as to let the water pass into the reservoir, but not to go back again the same way. The content of this reservoir or upper pond, is to be conveyed by the usual means over or under a water-wheel, and then received by another reservoir or lower pond, where it is retained till the time of low water, when it opens another valve-sluice, and discharges itself into the river or sea, from whence it was received. Upon this principle, a constant fall of water from the upper into the lower pond is obtained by means of the rising and falling of the tide, and that without requiring any person to attend it; for, whenever the water is higher in the river or sea, than in the upper pond, it will open the sluice and fill the pond; and whenever it is lower in the river or sea than in the lower pond, the weight of water in the latter will open the lower sluice.

To adopt this plan in places where the general level of the land is about half way between high and low water, nothing more would be necessary than to dig out the lower pond, and with the same earth make an embankment, which will form the upper.

The same principle may be applied to those tide-mills already in use, that work forwards and backwards. Let two small ponds, an upper and a lower, be dug, each capable of holding water enough to turn the mill about two hours: these may be called auxiliary ponds, and the original one the main pond. Let there be two channels for the water to go into the main pond, one under the water-wheel, and the other merely to fill the pond; and let there be a communication from the water-wheel channel to each of the auxiliary ponds, as well as from these to the river or sea. Then may the motion of the water-wheel be always kept up with due force: for, during the rising of the tide, and until within about an hour of high water, the current would be under the water-wheel and into the main pond as usual; but the force of the tide then slackening, the communication between the water-wheel channel and the main pond must be shut, and the current,

after passing the wheel, must be turned into the lower auxiliary; at the same time the tide must be admitted into the main pond through the other channel, and the upper auxiliary likewise filled. By the time the lower pond is full the tide will be running down strong enough to admit of the wheel being turned backwards, in the ordinary way, by the contents of the main pond passing back through the water-wheel channel. This will continue until about an hour before low-water, when the contents of the upper auxiliary pond must be carried under the wheel, and then discharged into the river or sea, and the main and lower auxiliary ponds allowed to empty themselves.

Observations.—We willingly give place to this improvement in the formation of reservoirs for tide-mills, because, notwithstanding the great utility and advantage of this kind of machinery, but little has been published relative to it in this country. The improvement now suggested is obvious enough, and may have presented itself to the minds of different theoretical men; it has not, however, that we are aware of, been adopted in practice; and Mr. Hawkins has our best thanks for thus giving it publicity. Our readers may turn to page 39 of our fourth number for farther information on this interesting subject, and to the first volume of the first Series of the Repertory of Arts.

Description of a thrashing Machine, made by Mr. Joseph Frost, *of Great Linford, near Newport Pagnel, Bucks.—Rep. of Arts, No. 75, Second Series.*

The machine now described is of the kind we adverted to in the observations at p. 142 of the last preceding Number: it consists of a horse-wheel of about twelve feet diameter, on a vertical shaft, which is entirely of wood, and turns a pinion of cast-iron on one extremity of a horizontal shaft, which has a larger iron wheel at the other extremity, working in the pinion of the thrashing drum; on the spindle of which is fixed another wheel to work two fluted rollers for regulating the supply of corn. Thus, with three combinations only, the thrashing drum is put into motion, and made to perform nearly 500 revolutions in a minute; and being furnished with twenty ribs, about 10,000 blows are struck in the same time.

A space of four feet by seven, and nine to ten feet high, includes the thrashing part of the machinery inside the barn. The horse part may be erected on the outside, and covered with a shed. More than 80 bushels may be thrashed in a day of 9 hours by 2 horses, and about 50 bushels with one horse. In either case three men are employed, besides a boy to drive the horse or horses.

The expense of this machine does not exceed 90*l.* exclusive of carriage and fixing.

Observations.—After what we have said on this subject in No. 14, it would be superfluous to expatiate here. The simplicity and merit of Mr. Frost's machine are obvious, and we trust he will reap the reward of his ingenuity.

Account of a floating Light, calculated to save the Lives of Persons who have the Misfortune to fall overboard in the Night from any Ship. Invented by Mr. WILLIAM SHIPLEY.—*Trans. Soc. Arts, Vol.* 25.

MR. Shipley's floating light consists of a hollow vessel of tinned iron plate made in the form of a boat, about 27 inches long, 13 broad in the middle, and 12 deep: from the gunwale of this boat a handle projects on each side, intended for the man who has fallen into the water to lay hold of, and thus support himself; the buoyancy of the boat being amply sufficient to keep a man from sinking. A frame-work and gimbals are affixed above the middle part of the deck of the boat for the reception of a swinging lantern, which is to contain a lamp, and which, by means of the gimbals, will always adjust itself to a position nearly vertical. It is recommended that this float be placed every night under the care of the officers on watch; that its lamp be frequently trimmed and supplied with fresh oil, and its wick moistened with oil of turpentine, in order that it may take fire with the least touch of a lamp or a candle. When a man falls into the water the lamp is immediately lighted, and the float which carries it is to be let down into the water by a small cord attached to an iron reel; the remainder of the cord is then made fast to the reel, and both thrown into the sea, in order that the weight of the reel may cause the cord to hang vertically, and thus be in no danger of entangling the legs of the unfortunate man. The light will direct him to the float, and as soon as he has reached it (for it is supposed he can swim) he is to take hold of the handles, and may move it very fast which way he pleases, only by striking his legs in the same manner he does when he swims. The ship on tacking about is directed by the light to the float; and, having come near it, the man is rescued from the watery element by the following process;—A lantern with a rope ladder is to be let down by a cord from the ship, till a cross bar below the lantern (but not at the bottom of the ladder) touches the water, which the mariners in the ship may see by means of the light from the bottom of the lantern; and thus the man in the water may lay hold of the cross-bar, and fix his feet on one of the steps of the rope ladder, when he may lay hold of the iron

handle of the float with one hand, and hang it on a hook projecting from the ladder above the cross-bar; which being done, the man and float may be both safely raised into the ship.

Observations.—This contrivance of the respected founder of the Society of Arts is by no means free from objections. It may, however, be useful, either by night or by day, in moderately calm weather; and on that account deserves to be introduced aboard our commercial vessels and ships of war.

Method of saving Persons from stranded Ships. By Lieut. JOHN BELL *of the Royal Artillery.—Trans. Soc. Arts, Vol.* 25.

IN this method a mortar is to be provided with a chamber capable of containing one pound of powder, and a bore to admit a leaden ball of 60 lbs. or upwards. When a ship is stranded the mortar is to be elevated to about 45 degrees, and a rope or deep-sea line is to be fastened by one end to the ball, while the line itself, being coiled round parallel hand-spikes, may be easily and rapidly unfolded to its full extent. On the discharge of the mortar towards the shore, the ball will carry with it the line or rope, and by burying itself into the earth make that end of the rope fast, while the other end is in the stranded vessel: thus the rope becomes stretched between the vessel and the shore, and a communication thence established by means of rafts. The rafts recommended by Lieut. Bell are each formed by lashing together with ropes five empty water-casks belonging to the ship, and tying above them a seaman's chest, with holes cut in its sides, to prevent its filling, and to allow the person who rides in it better convenience for taking hold: pullies are attached to this chest through which the rope is to run: the raft is also to be ballasted underneath, to prevent its upsetting.

The mortar and necessary balls or shells that would be useful on such an occasion might form a part of the ballast of the vessel; and whenever a ship is driving or unmanageable near the shore, the mortar might be brought on deck, and the apparatus prepared. In some cases grapnels may be advantageously fired from common ordnance to answer the same purpose.

The following is a relation of some trials made before a Committee of the Society of Arts, at Woolwich, in August 1791.

From a boat moored about 250 yards from shore, the shell was thrown 150 yards on shore, with the rope attached to it; the shell was of cast-iron, filled with lead; it weighed 75 lbs., its diameter 8 inches; the rope in the trial was a deep-sea line, of which 160 yards weighed 18 lbs.; the angle of the mortar, from whence the shell was fired, was 45 degrees. By means of the line, Mr. Bell and another man worked themselves on shore upon

his raft of casks; there were many links in the rope; but they were cleared with ease by Mr. Bell, with the assistance of his snatch-blocks.

The second trial was repeated in a similar manner, and with equal success, the shell falling within a few yards of the former place: the gale of wind was brisk, and the water rough. The direction of the shell was nearly from north to south, and the wind blew nearly north-west.

In the third trial, the mortar was elevated to 70 degrees; the rope attached to the shell was an inch and half tarred rope, of which every 50 yards weighed 14½ lbs. The shell was of the kind above mentioned: it fell 160 yards from the mortar, and buried itself about two-thirds in the ground: the line or rope run out was about 200 yards, and it required the force of three men to draw the shell out of the ground at that distance.

Observations.—There can be little doubt that, in many cases when vessels are stranded near shore, the adoption of the means pointed out by Lieut. Bell would tend to the preservation of many valuable lives: and since a suitable piece of ordnance, with a block carriage and leaden balls, would not cost above 11 or 12 pounds sterling, the expense furnishes no objection of moment. Indeed in trading ships such a piece might farther answer the purpose of making signals of distress, by filling the chamber with powder and well wadding it, when the report of the firing would be heard to the distance of some miles: and, in the defence of a ship, such a gun would be highly useful, on account of the facility which its shortness gives to its loading and firing.

In the experiments made a short time ago at the Cape of Good Hope, keeping the same object in view, the shell, with the rope attached to it, was discharged from a mortar *on shore*; it was thus fired *over* the ship, and the rope kept up by some of the rigging; then it was made fast to the top-mast; another rope, by means of a heavy pulley, conveyed down from thence to the shore; and the two ropes being fastened parallel to each other, persons were conveyed from the ship to the shore by means of hammocks or cots sliding down the ropes by rings and pulleys. The experiments now carrying on at Woolwich by Captain Manby are, we understand, conducted with a view to the ascertaining how far a mortar with a medium charge will carry a shell, having a rope fastened to it; and we believe the maximum distance is about *eight hundred yards*. With regard to the two methods, that of firing from the ship, and that of firing from the shore, there can be no doubt that the former is preferable, and will be more generally efficacious. In nineteen cases out of twenty where a ship is stranded near shore, there may be no such thing as a mortar or a shell within many miles; for it is not very likely, when the fear of invasion will not cause the complete fortification of a coast, that the expectation

of the loss of a vessel now and then should lead to the placing of men with mortars, shells, and ropes, at proper distances upon every coast where wrecks may happen : besides, suppose them placed, still a boisterous wind may produce such a lateral deviation of the shell from its regular track, especially when a rope is tied to it, that it may be extremely difficult to fire so as to convey the rope to the ship ; while the transmission of the rope to land by firing from the ship would be always certain when the distance of the ship from the shore was not too great. In short, what has been done at the Cape of Good Hope and at Woolwich, appears to us a retrograde step in the order of invention. There can be no doubt that Lieut. Bell *thought* of the method of firing from the shore ; but he would also see at the same time, that it was very confined in its application, and depended upon contingencies which no one could command ; while the mariners could always have recourse to the other method when they were near enough to the shore. The present attempts, therefore, do not diminish Bell's claims to the thanks of the public, but rather indicate a paucity of invention on the part of those concerned in them, which certainly does not call for any particular commendation.

Account of a musical Instrument, called an organized Lyre ; invented by M. Adolphus Ledhuy.—*Sonnini's Biblio-Phys. Econ.* 1807.

The description of this instrument is as follows :—

1. It has 15 strings, separated into three distinct divisions, and embracing the compass of four complete octaves. The three divisions are called the bass, tenor, and treble.

2. It has a row of 6 keys, which include the extent of three octaves. The piano-forte may be imitated with these ; but the sounds they produce are more soft.

3. By means of a mute the performer may change the sound of the instrument, either gradually or instantaneously ; from the loudest of which it is susceptible to the softest, or the contrary. In applying this mute, it is not required for the performer to employ his hand, or stop his performance ; all that is necessary is for him to press his arm on a kind of lever, which is precisely at the place where the arm rests habitually on the instrument, and to increase or diminish the pressure till the mute produces the desired effect.

4. The instrument has two necks, each with six strings, which are fingered in the same manner as the guitar-lyre.

5. The case of the instrument, which is indispensably necessary for its conveyance from place to place, is equally so for playing on it ; because the performer being obliged to have the left knee raised a little, the better to support the instrument, and to give

freedom of movement to the arm, he rests his foot on the box, out of which rises a stand for the music, which may be raised or lowered at pleasure. This stand folds up so as not to increase the size of the case, and adds but little to its weight.

Observations.—As far as we can judge from this concise description, there is much ingenuity in the construction of M. Ledhuy's organized lyre. It is a considerable improvement upon the common guitar-lyre; and if, by the simple mechanism of the inventor, the performer can imitate (as he tells us) a variety of instruments, such as the lyre, the harp, the piano-forte, &c. we know not any instrument of equal simplicity which will bear a comparison with it. The inventor tells us, it has been the subject of much commendation among the first artists in Paris; and we find he has taken out a patent for his instrument in France.

Account of a Method of using Chains in raising Coals, or other Articles, from Mines. Invented by Mr. GILBERT GILPIN, *of Old Park Iron-works, near Shifnal.—Trans. Soc. Arts, Vol. 25.*

THE design of Mr. Gilpin's contrivance is to keep the chains evenly and equally stretched on the barrels, by which they are drawn up from the mines, so as to prevent twisting and crossing, which renders them liable to snap.

For this purpose a spiral groove is formed round the barrel by narrow slips of iron, fastened about its surface in continuation, so as that each revolution of them shall be at a regular distance from those next adjoining, equal to the thickness of a link of the chain. In the spiral groove thus formed the edges of every second link of the chain fall as the barrel is turned round, which keeps them in a vertical position, while the intervening links lie flat on the edges of the iron slips; when the iron slips (called tire by Mr. Gilpin) are to be fastened on conical surfaces, they are shaped so that their section forms a moulding of two elevations, the upper of which is double the height of the lower; by which the surfaces of the grooves are made to assume a level position along the face of the cone, as they are formed of the upper half the lower ship, and of the lower half of the upper slip next to each other.

Mr. Gilpin recommends the use of conical barrels formed of two frustrums of cones with their bases joining in the middle, each frustrum to work a separate chain, by which the weight of the ascending chain will tend to balance that of the descending chain more equally. Mr. G. proves mathematically, that by making the weight of the basket of coal to that of the chain, and the perimeters of the extremities of the frustrums which form the barrel, to each other in the proportion of 2 to 1, a maximum is obtained by which a barrel of this description requires one third less momentum (and consequently *one third less expense)* to work it than a

cylindrical one. The pullies, over which the chains pass to the pits, are formed with grooves also to keep the chains even.

The chains and apparatus were in use for three years previous to February 1807, without a single link breaking, or any other accident having happened: the wear has been so trifling, that Mr. Gilpin thinks the chains will be destroyed more by rust than attrition, and will last at least fifteen years in this way; but even supposing they last but twelve years, from the subjoined comparative statements, the expense of chains will be only a twenty-fourth part of that of hempen ropes.

Expense of tarred Ropes for raising Coal from a Pit eighty Yards deep, for three Years and four Months:

	£.	s.	d.
For ropes, each 110 yards long, 6 inches round, and 5 lbs. per yard, 5500 lbs. at 8*d.* per lb. - -	183	6	8
Deduct ten worn ropes, 2750 lbs. at 1*d.* per lb. - -	11	9	2
Net expense of ropes for three years and four months	171	17	6

Expense of Chains for raising Coal from the same Depth:

	£.	s.	d.
Two chains, each 110 yards long, of 3-8ths of an inch iron, 28 links to the yard, 5 lbs. to the yard, 1100 lbs. at 6*d.* per lb. - - - - - - -	27	10	0
180 yards of wrought-iron tire, with the holes punched, 7 lbs. per yard, at 1*s.* 6*d.* per yard - -	13	10	0
540 nails for the tire, 27 lbs. at 6*d.* per lb. - - -	0	13	6
Nailing the tire on the barrel, 180 yards, at 2½*d.* per yard	1	17	6
	43	11	0

The Society for the Encouragement of Arts, &c. voted Mr. Gilpin a premium of twenty guineas for his invention.

Observations.—There can be little doubt that chains, wherever they can be employed, will be much cheaper than ropes. They have already been used with very good effect for mooring ships instead of cables, and many suppose they might be substituted for cordage for the standing rigging of ships, with great efficacy and economy.—See the account of Slater's patent chain-rigging in our first volume, p. 76.

Mr. Gilpin's plan will obviate the risks to which chains are liable from twisting and crossing, very effectually: but there is one defect, to which they are subject, on which it will have no effect: the chief reason why workmen prefer ropes to chains is, because ropes give some signs before they break, when they say the ropes *complain*; but chains shew no sign before they break, by which the threatened evil may be avoided, but snap suddenly,

and destroy every thing connected with them at once: for this defect, Mr. Glipin's method affords no remedy. But we are inclined to think, that if chains were formed with double links, this danger would be greatly diminished, as it would scarcely ever happen that two links would snap at once. The links might also be formed with a small spiral twist, and then a weak link would probably shew some symptoms of its state by becoming somewhat longer than it ought to be previous to its breaking.

Description of an Implement for closing Boots and Shoes in a standing Posture. Invented by Mr. A. Staas.—*Trans. Soc. Arts, Vol.* 25.

This implement for closing boots is a sort of wooden vice, shaped at its upper part, where it holds the leather, like the instrument used by sadlers for holding some of their work for a similar purpose, while the rest of it is formed like a pair of nippers, having two handles united by a joint, which being pressed together, close the upper part with some force. These wooden nippers are supported at the joint by a hollow piece of wood, which keeps them in an upright posture, and a strap descends from each of the handles to a treadle placed beneath, which, when pressed by the foot, tends to close the nippers, both by the direct pull of the straps, and by the pressure of the hollow piece that encloses the joint, against the sides of its claws, which operates as a wedge in closing them on account of their gradually extending outwards before they join at the top. The hollow piece that holds the nippers is supported by a three-legged stand of a convenient height for a man to work at it; its upper part is formed into a little table with a ledge to hold tools; beneath it is a drawer and a shelf for the same purpose; the hollow piece is fixed to this stand by a tenant projecting from it that enters into a mortice in an upright piece of a plank that forms part of the stand; this upright plank has three mortices, one oblique, and the two other vertical: the tenant can be fitted to any of the three mortices; the oblique one is used for sadler's work; and the other two are only for fixing the implement at different elevations: there are two mortices also in the face of the table, one in the front, and the other at the back, in which the foot of a piece of wood may be fixed, formed at the top into an half-cylinder, which is useful in closing boots; this piece of wood, with its foot the same, resembles a carpenter's square.

Mr. Staas got the silver medal for this invention.

Observations.—Though Mr. Staas has before been honoured by a premium from the Society, this is in fact his first invention; that for which he before obtained the premium, was really Mr. Parker's

invention. See observations on this subject in our third volume, page 74; for Parker's invention, vide vol. ii. p. 444; and for one for the same purpose by Mr. Holden, which was the first invented, see vol. i. p. 64.

We must own we should be surprised at Mr. Staas for still persevering to call Mr. Parker's invention his own, if the oversight of the Society in giving him a premium, for the same thing for which they had before rewarded Mr. Parker, did not in some degree excuse him.

On Vision. By Ez. Walker, *Esq.—Phil. Mag. No.* 122.

Mr. Walker's object in this paper is to defend himself against our late remarks on his former essay. In order to shew that a lens has its focal length diminished by contracting its aperture, he adduces an experiment in which the image of a neighbouring candle was formed distinctly, at the same distance from a lens, as had served to afford a perfect image of the moon, before the contraction of the aperture, to one-fifth of an inch. He has attempted to repeat the experiment made by looking through two minute holes, and he says that "it is erroneous." He adopts our explanation of the difference between distinctness and brightness, and expatiates on it with great eloquence, for our particular instruction. The image of the line before mentioned, he says was rendered much less distinct by removing the glass, notwithstanding the imperfection of the forms. A certain transit telescope in his possession exhibits no image of a small object at a moderate distance, except when its aperture is contracted to one-fifth of an inch. By means of a minute hole in a card, a nearer and a remoter object may be seen distinctly at the same time; even more distinctly than either can be seen separately by the naked eye.

Observations.—We have noticed the heads of this paper as concisely as possible, because we cannot help thinking it a waste of our own time and of that of our readers to enter into long discussions with a person who has the courage to assert, that the focal distance of a lens is shortened by contracting its aperture, and to observe, that "the bare assertion of an anonymous writer" does not alter the truth of the proposition. Let him take the trouble of looking at Huygens, Smith, Wood, the Encyclopædia Britannica, or any other good work on mathematical optics, and he will see on what foundation this "bare assertion" rests. Let him invert his experiment with the candle and the moon, and he will observe, that the contraction of the aperture appears to be equally favourable to distinctness in both cases. When he tells us, that "if there were any alteration in the refractive powers of the

eye, we might then see one point single and the other double, when viewed through one minute hole," he shews such a degree of inattention to the true principle of the experiment, that his evidence respecting the result must be absolutely of no value. The remaining observations and experiments are wholly irrelevant to the point in question; they only tend to shew what is confessed on all hands, that a diminution of aperture is highly favourable to distinct vision, whenever the illumination is sufficient.

Account of the third Voyage of the Ship Economy, built according to Mr. J. W. Boswell's patent Plan.—Rep. of Arts, No. 76, Second Series.

It appears, by a letter of the master of this ship, that the vessel, although deeply laden, with a large proportion of bricks and ballast, made a very good voyage to Demerara, in the course of which she experienced several very heavy gales. The ship brought home for the most part coffee in bags, for which cargo she is well adapted. She is now in dock to get a clean bottom, and is in such good order as to be fit for any voyage, without the least repair or even caulking. The sheathing is perfectly free from worms: in putting on this sheathing, the seams of the bottom were carefully caulked, and paid with common pitch, and the bottom paid with coal-tar. The sheathing-paper was very thick, and dipped in coal-tar, and the sheathing was put on without hair. The seams of the sheathing were caulked and paid with common pitch, and then a good coat of coal-tar over all.

As this mode of building has answered in a ship of 200 tons, it must be evident that still greater advantages would arise from building larger ships, on the same plan, especially as, when the ships are above 500 tons, the greater part of the timber required for the frame would cost only half the present price.

The sheathing of the Economy was, on her first voyage, painted with white lead; nevertheless the sheathing was much cut by the worms, which was partly owing to her long detention in the West Indies by the French fleet. On her second voyage, she had a brimstone bottom, which was also much cut. The superior advantages of the sheathing put on with coal-tar, are evident.

A French Count (Viscomte de Vaux), in a treatise lately published on finding the longitude, lays claim to Mr. Boswell's invention for ascertaining the rate of a ship's way, which he published in the Repertory of Arts, No. 61, and insinuates that Mr. B. borrowed the plan from him, through the medium of the Admiralty. But Mr. B.'s method was published near a year before the Count's treatise on finding the longitude, and so far from

Mr. B. having any interest with the Admiralty, he says he cannot procure from them a copy of the Report of the Navy Board on the ship Economy, and on the plan on which she is built.

Observations.—Mr. Boswell seems determined that the public shall hear often enough of his ship Economy, as he is continually bringing the subject before them in every possible shape. It is needless to add any thing to what we have before said on this subject, in vol. i. p. 75.

As to his instrument for measuring a ship's way, of which an account was given in vol. iii. p. 359, Mr. B. certainly maintains his claim to the invention.

In the Athenæum for last month, a writer enters into a detailed account of the conduct of the Admiralty and Navy Office, in respect to the adoption of improvements in the marine service. One of the principal members of these Boards told him, that it could not be expected they should adopt his mode of building; for if any accident should at any future period happen to the vessel, it would be attributed to the mode of its construction, and they would be blamed for what was entirely accidental. This sentiment is indeed universal in the Navy and Ordnance Boards; and it is well known that they never give attention to any suggestions, however plausible they may appear, unless they are brought forward, or at least patronised, by commanders in the army or navy: we wonder that the writer should allege this to their discredit, since these Boards being merely ministerial, it would be an impertinent meddling with that which does not belong to them. At the same time we cannot but notice an unfair advantage which is sometimes taken by the officers of the navy, and particularly by those of the artillery, to procure intelligence of the projects offered to these Boards, and after some time, when the project has been forgotten, to produce them to the public as their own. It appears by a late number of the Gentleman's Magazine, that Mr. Hume, of Long Acre, has brought forward an assertion of this kind, in respect to the fire-rockets, of which there was a few months ago so much talk.

Account of Captain Cowan's *improved Sails for Ships.—Rep. of Arts, Second Series, No. 76.*

Captain Cowan here brings forward several reports respecting the benefits arising from his method of making and reefing sails. The reports are from Captain Lewis Shepheard, of the Thisbe; Captain J. Sykes, of the Nautilus; Captain Alexander Shepheard, of the Surinam; First Lieutenant (now Captain) J. Stuart, of the Minotaur; Mr. Edward Harper, owner of the Cognac Packet,

and Mr. F. Hornby, master of the Birna, of Grimsby; all of whom agree in recommending this mode of constructing sails, as being peculiarly advantageous in gales of wind on a lee shore, as enabling the commander to reef the sails without starting tack or sheet.

Observations.—In vol. ii. p. 386, a full account of these sails was given, to which we refer the reader, for an explanation of their construction, and an enumeration of their advantages.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, DURING THE MONTHS OF JULY, AUGUST, AND SEPTEMBER, 1808.

Mr. EDWARD WEEKS's *Patent for a forcing Frame, on a new and improved Construction, for raising and forcing of Cucumbers, Melons, Strawberries, and various other Fruits and Plants, which require the Application of artificial Heat, to rear or ripen the same. Dated March* 1808.—*Repert. of Arts, No. 74, Second Series.*

THESE forcing frames consist of two parts: the external frame is covered with glass lights, and differing only from the common frames by having a gutter along the front to carry off the rain-water, and thus prevent it from injuring the lining of dung placed in front of the bed.

The internal frame is shallow, without any covering, and having a boarded bottom, of sufficient strength to support the weight of the earth and plants placed upon it, and bored with many small holes, to drain off the superfluous moisture. This internal frame is suspended in the external one by means of chains passing over a spindle furnished with a handle, and rack-wheel with a stop, so that it may be hung at any required height from the dung, and that this height may be changed as the growth of the plants may require. By this means the plants may not only be made to receive greater benefit from the sun, but their roots are prevented from being burnt by the too great heat of the dung.

Observations.—There can be no doubt but that this invention is a considerable improvement in horticulture, as it relieves the gardener from the necessity of an hourly attention to the state of his hot-bed, and particularly as it enables him to raise the youngest plants, so that they may enjoy the vivifying effect of the solar rays.

Mr. Charles Dibdin's *Patent for a Method of facilitating the Learning of Music. Dated April* 1808.—*Rep. of Arts, No. 74, Second Series.*

The proposed improvements of this patentee consist in substituting the letters used in printing, the marks of punctuation, characters of reference, &c. for the characters used in music to express the modifications, divisions, &c. relating to tone and time.

Thus, instead of the semibreve, minim, crotchet, quaver, semiquaver, and demi-semiquaver, it is proposed to use the period, colon, semicolon, comma, semi-comma, and demi-semi-comma. The cliff and staves are to be done away, by the use of letters: the first seven or lowermost bass letters are to be large Roman capitals; the second seven, large Italic capitals; the third seven, small Roman capitals; the fourth seven, small, or lower-case, Roman; and the fifth, or upper seven, small Italic. Instead of the sharp and the flat, the acute and the grave accents are to be used: the patentee rejects the use of the *natural*, saying, if a letter be unaccented it will be played natural, of course.

Instead of the single and double bar, it is proposed to use an m dash — and a section §; for an indefinite a double m dash, like the mathematician's symbol of equality =; and for a definite pause, a triple m dash ≡. Any point with an *r* above it will denote a rest; thus $\overset{r}{:}$ will denote a semibreve rest, and $\overset{r}{;}$ a crotchet rest. Instead of the repeat is to be used an index ☞; instead of the bind, if the distance from letter to letter be short, will be used a hyphen -; and, if long, a half parenthesis ⁀; a slur will also be expressed by a half parenthesis ⁀: a half bracket ⌐ will indicate how many musical letters go to a syllable in singing; and a brace will be placed at the beginning of the lines, to connect the bass and treble parts. A 4 placed above a semicolon will denote common time; a 3 above a colon, the triple time of $\frac{3}{2}$; a 3 above a semicolon the triple time of $\frac{3}{4}$; a 5 above a comma, the time of $\frac{5}{8}$; and so of others. The apogiatura is to be represented by a small letter raised a little above the others, in the manner letters of reference to foot-notes are sometimes placed. The several graces and varieties in the movements are to be denoted by English words, as shake, trill, slow, quick, &c.

The specification is accompanied by a figure of keys of a forte-piano, &c. marked agreeably to Mr. Dibdin's new method; and by a song in two parts so written as to illustrate his meaning fully. He also recommends pasting printed letters on the keys of the instrument, which would wear off as the pupil becomes perfect.

Observations.—We shall expect to see ere long the specification of a patent for a method of facilitating the art of forgetting all a person has learned: for such a patent would deserve as much encouragement as the present. If Mr. Dibdin's *improvements* were introduced universally, "the learning of music," instead of being "facilitated," would be rendered more difficult, so far as relates to musical notation or musical language, than it was in the eleventh century previous to Guido Aretino's invention (or at least improvement) of the stave. For, in that dark age, they had light enough to see the advantage of indicating elevations and depressions of tone by corresponding elevations or depressions of the letters; whereas our patentee proposes that his letters should be ranged regularly in horizontal lines. The objections to Mr. Dibdin's scheme are numerous; and the writer of this article can say *from experience,* that in practice they are very forcible: for, about 14 years ago, when he was a very young man, he was struck with the whim of employing a method extremely similar to Mr Dibdin's, in the instruction of a female relative, who had neglected the study of music till she was about 24 years of age, and could devote but little time to it. It was soon found, however, that this scheme, instead of lessening the difficulties, nearly doubled them.

First, In the method now proposed, most of the advantages resulting from an eye-glance of a piece of music, written in the usual way, are entirely lost. When music is arranged on staves in the usual manner, with the cliffs, the flats or sharps, the bars, &c. distinctly marked, a single glance will teach even a novice what is the nature of the movement as to time, as well as to the expression of lively, or pensive, &c. what the key, and where it is placed. Thus he will at once know what flat or sharp as well as natural notes, are likely to be required in the performance of the piece, and, of course, will better prepare his mind for the proper execution: an advantage which he must pore a long time over a tune set in Mr. Dibdin's way before he can obtain.

Secondly, In the common manner of reading music as usually written, the eye assists and guides the performance almost without effort, and while the performer stands or sits in a graceful position. The size of the musical characters enables them to be read with ease, at any moderate distance; the variations of the notes in point of gravity or acuteness, their relative durations in point of time, the transitions from lively to plaintive, and *vicè versâ,* the relations of the different parts with regard to harmony, may be caught by a glance, and the feelings and execution of the performer modulated accordingly. But in Mr. Dibdin's method, if the performer have not microscopic eyes, he may pore till he is purblind, to read his music, to distinguish periods, and colons, and commas, from *semi-commas,* and *demi-semi-commas* (which latter character, by the way, Mr. D. has not taught us how to make, and

we really are at a loss without his instruction); and, after he has made them out, he must use a distinct effort of mind, to transfer his small and large capitals, his lower-case, his Roman and Italic letters, with accents, and punctuation, to the notation appropriate to the instrument on which he is playing. The expedient proposed by the patentee of pasting the letters on the keys of the pianoforte, &c. would only serve for instruments which have such keys; and would, even in that case, be objected to by every music-master, who is acquainted with musical science, and has acquired any skill in teaching.

Thirdly, Supposing the preceding objections to vanish, there would still remain a very formidable one. Is the pupil to be afterwards taught the customary notation? If so, he has the labour of learning *two distinct notations*, the acquirement of one of which does not at all facilitate the acquisition of the other; and of which indeed, the established one is full as easy to learn at the commencement of the study, as the other. If he is not to be taught the established notation, he is placed in the situation of one who should be precluded the use of all but English books, and should be confined to converse with none but Englishmen, and yet, through some amazing perversity of his parents (who knew all this), have been instructed in none but the Hindu language. Mr. Dibdin's pupil must be at the immense labour of translating every new tune into his peculiar language, or rather he must get this done for him (for, by the supposition, he cannot accomplish it himself); and then he will have the delightful enjoyment of singing or playing a tune, which nobody but himself can understand; we mean, so as to tell whether he be right or wrong, or to join in concert with him, unless it be a tune previously known and practised.

We could mention other objections, but we are afraid of extending this article beyond the limits due to the importance of the subject. There is nothing we find to commend in Mr. D.'s specification, except the attempt to get quit of the words adagio, presto, &c. As the meanings conveyed by these words could be equally conveyed by purely English ones, the retaining them is certainly pedantic: we are glad to remark that *some* of our most celebrated living composers are suffering the foreign terms to fall into neglect: *O si sic omnia!*

Mr. William Hawkes's *Patent for Improvements on musical keyed Instruments of twelve fixed Tones. Dated July* 1808.—*Repertory of Arts, No. 76, Second Series.*

Mr. Hawkes's improvements in the organ are effected by a pedal under the key-board, and an extra slide to every stop in the sound-board, to correspond with the general slide. This extra

slide has a communication from the sound-board to the extra pipes, namely, sharps and flats; which by depressing the pedal with the foot brings on the sharps scale; and by elevating the pedal brings on the flat scale: and as the flats go off, the sharps are brought on; and inversely, as the sharps go off, the flats are brought on, by the action of the pedal communicated to the additional slide, with double holes adapted to the additional pipes, viz. five pipes to each octave.

In stringed instruments, such as the piano-forte, the improvement is effected by adding seven diatonic and five flat tones to our present scale of twelve fixed tones, which form two chromatic scales; the one termed a flat scale, and the other a sharp scale; and is done by two sets of strings, of two unisons to each set, which are acted upon, without the addition of a key to the key-board, by a pedal, by which the key-board is made to move forward and backward about one-fourth of an inch, the same hammer striking each set of strings both in the flat and sharp scale, by depressing the pedal with the foot when the sharp scale is wanted, and elevating the pedal when the flat scale is wanted.

Observations.—We know not whether the brevity in Mr. Hawkes's specification be intended or accidental: but, be this as it may, it is certainly such as puts it completely out of our power to say, whether his invention is such as is well calculated to answer the purpose he had in view.

Mr. John Dickson's *Patent for an improved Method of constructing Cocks for stopping Fluids; and which, by one Motion or Operation, will permit such Fluids to pass in different Directions. Dated March* 1808.—*Rep. of Arts, No. 75, Second Series.*

Mr. Dickson's cock, or we would rather say, his sliding valve, consists of a flat piece of brass having a rounded cavity at its under side; and ground to fit an iron plate so perfectly, that neither air nor water can pass between them. This plate has two oblong apertures posited, so as to lie across the path of the valve, and there is a suitable interval between these apertures. Besides the former fixed plate there is a moveable plate, which has a curve space cut in its surface, sufficiently wide to cover both the apertures and the intermediate space in the face of the fixed plate; so that fluids may pass from or into both the apertures of the fixed plate at the same time. The moveable plate is fitted to a cylindrical tube, so as to move in it like a piston by means of a rod and stuffing-box, while a spring causes it to press closely against the fixed plate: and there is another orifice in the side of the tube opposite to the two apertures in that plate. Now, by means of this arrangement, the alternate motion of the piston causes a commu-

nication to be opened or cut off at pleasure, between either of the apertures in the fixed plate, and the orifice on the opposite side of the tube; in consequence of which, fluids may be made to pass either into or out of vessels connected with those apertures, and have either an entrance or a discharge by the opposite orifice.

Similar apparatus may be applied to a double-acting steam-engine: and the specification is accompanied with figures, illustrating the manner of application; engravings of which are given in the Number of the Repertory of Arts, &c. mentioned at the commencement of this article.

Observations.—Mr. Dickson's sliding valve is an ingenious and useful contrivance: its mode of application to steam-engines is extremely simple, effectual, and successful: the evils resulting from irregular friction, are in great measure avoided; and the trouble, expense, and risk of several minute joints and pieces, almost entirely got quit of. We therefore cheerfully recommend it to the notice of the public, not doubting that in a great variety of cases to which it can be applied, it will be found safe and advantageous.

Mr. John Shorter Morris's *Patent for a Machine for Mangling. Dated Feb.* 1808—*Rep. of Arts, No. 75, Second Series.*

This mangle is constituted of four horizontal rollers, the pivots of which play on suitable supports in a stout wooden frame put together with bed-screws, To avoid circumlocution, we shall denote these four rollers by the letters A, B, C, D. The two rollers A and B, whose axles bear on brass or iron, let into the wooden frame, are posited side by side, but not so as to touch. C is a moveable roller, about which the linen or cloth to be mangled is rolled, and it is then placed upon the rollers A and B, so as to lie in part between them. The axis of the fourth roller D works in pieces of brass or iron, which slide between two other pieces of metal, so that this roller D admits of elevation and depression, by means of a lever working upon a horizontal shaft (at the top of the frame), and chains of suspension. The pieces of metal in which the axle of the roller D runs, have long vertical pieces of iron attached to them, so as to reach below all the rollers; and to hooks at the lower extremities of these irons are hung chains carrying either a rectangular platform loaded with weights, or a rectangular box containing stones or other ponderous matter.

In using this machine, the lever is pressed down and fastened by a hook; by this process the roller D, and platform below all, is elevated: then the linen to be smoothed is wrapped about the

roller C, which is next laid to rest between the rollers A and B. The lever is then freed from the hook which kept it down, and the action of the ponderous matter on the platform brings the roller D into contact with the roller C: in this state a rotatory motion is applied to all the rollers by means of a winch fixed to the axle of D; and in a short time the pressure of the roller C, against A, B, and D, will give the requisite smoothness to the linen.

The patentee says, this machine will act best with a wheel on the axis of each of the cylinders A and B, and a pinion between them, with a fly-wheel on the axle of the pinion, to which motion being given, all inequalities of pressure will be conquered with great ease. This machine is not confined to mangling only, but may be used with success as a copper-plate printing press, a letter-copying machine, &c.

Observations.—This machinery for mangling, which, as our readers will perceive, is nearly on the principle of the common calenders, seems very well calculated to answer the end proposed. It will do extremely well for table-cloths, sheets, &c.; and if it be not so fully applicable to the smoothing of small linen, that happens because such linen ought rather to be ironed than mangled, and is not attributable to any radical defect in the structure of the apparatus. It is very compact, and may undoubtedly be made neat, strong, and of a convenient size, at a moderate expense.

Mr. Charles Lucas Birch's *Patent for an Improvement in the Construction of the Roofs and upper Quarters of Landaus, Barouche-Landaus, Barouche-Curricles, and other Carriages, the upper Parts of which are made to fall down. Dated July* 1807.—*Rep. of Arts, No. 75, Second Series.*

Mr. Birch describes his method thus: Frame and fix in the top quarter rails to the tops of the standing pillars and slats, and fix the slats to the neck plates; rabbit the inner parts of the standing pillars, the top quarter rails and the slats, and board them with thin deals, or any other proper material. Let the crown pieces or cornice nails be long enough to bevel or mitre into the corners of the top of the standing pillars; and let in the hinges and thimble catches on the top of the crown pieces, and top of the quarter rails. Fix on the hoop, sticks, and back and front rails, and board them all up except the two hoop sticks which are nearest to the hinges, which may be placed as close as possible to admit of the head striking conveniently low. Conceal or let in one or more boxed locks to the centre hoop sticks, or at least the hoop sticks which unite the thimble catches, and fix them so that they may be opened by a key on the inside of the carriage. Stretch strong canvas or other fit material, and suitably fasten it both on the inside and the outside of the slats and elbows, and stuff it be-

tween with flocks, or tow, &c. Fasten canvas also, or other proper material, to the top hook sticks on the roof which are nearest the hinges; and then put on the leather covering.

Observations.—According to this principle of construction, a carriage will admit of one or more imperials upon its roof without interfering with the regular process of opening it; and the spring curtains to the landaus remain without being removed, while it is necessary to take down those on the old plan, before there is a possibility of opening it.

Mr. James Caparn's *Patent for a Machine for discharging Smoke from smoking Chimnies. Dated October* 1806.—*Rep. of Arts, No.* 75, *Second Series.*

Mr. Caparn's smoke disperser consists of a metallic barrel which may be fitted to the top of the funnel of a chimney, and carries a cap which is constituted of vanes or flyers, each shaped obliquely, yet so approaching to each other, as to make a regular exterior covering, while the interstices between the flyers admit of the escape of the smoke, and seem to facilitate that escape; because the elastic force of the smoke communicates a rotatory horizontal motion to the flyers, or a vertical spindle properly supported by cross bars from the barrel. The whole contrivance is illustrated by diagrams, but it is too obvious to be described more at large in this place.

Observations.—The principal advantage this construction appears to possess, is, that it in great measure prevents the obstruction of smoke by the external action of the atmosphere. But this apparent advantage may, in some cases, be counterbalanced by the operation of such causes as will keep the moveable cap from turning, causes of which there may be many arising either from the position of the chimney, the direction of the wind, from coagulation or loss of oil, or from corrosion of the materials: and when the cap is at rest, it manifestly furnishes of itself an obstruction to the escape of the smoke. On the whole, we think the simple contrivance, described at page 57 of our third volume, used aboard the canal track-boats in Ireland, would in all cases be equally efficacious, nay, in some, more efficacious, than Mr. Caparn's invention. And since it is more easily constructed, and requires no supply of oil, or other attention which it would be inconvenient to give at the top of a chimney, we think it on that account, at least, deserves the preference.

Messrs. JEFFERSON, ELLIS, *and* GALLOWAY'S *Patent for a Machine, or Machines, for the Purpose of finishing, glazing, and glossing of Leather—Rep. of Arts, No. 75, Second Series.*

THIS machine may be moved either by manual labour or otherwise; a single horse having sufficient power to work two engines, which, under the management of two men, will not only glaze, grain, and finish as many skins as could be done by a dozen workmen, but also execute the work in a superior style.

The engine may be made either single, or double, which latter is most advantageous; for, as the leather must be made damper in the process of rolling on, than in rolling off, and a cast-iron table, which is in general most advantageous for the skins to be placed on, is liable to rust which might discolour the leather, it is better to employ a table of brass for one of the machines.

The machine has a strong shaft, upon which are fixed two cast-iron plates about thirty inches diameter, and placed about 4 or 5 inches from each other. To the external surfaces of these plates are connected 4 or more iron cocks, extending about $2\frac{1}{2}$ in. above the surface of each plate, which carry drawing-and-pushing screws, which draw in and throw out chops that carry, on square bolts, fluted rollers of box-wood from 3 to 6 in. diameter, and about 2 in. wide; the remainder of the space between the chops being filled with plain box-wood blocks, which not only save a great expense in the rollers, but also possess the advantage of ranging the rollers upon the plates, so as to take six inches of the width of the skins in one revolution of the shaft, as well as being able thereby alternately to use any two inches of the width of the table that are opposite to the distance which the roller plates occupy. When a single machine is used, and the roller plates have six rollers mounted upon them, three may be used for rolling on, and three for rolling off; by drawing back the set of rollers that are not in use. The rollers must be rounded a little at their edges, to prevent them from cutting or indenting the leather, and when any particular part of the roller becomes worn, it can be shifted on the bolt, so as to present a new surface to the table.

The table on which the skins are placed, is about 10 in. wide, made of hard wood, brass or cast-iron bent up in the form of the quadrant of a circle of a proper radius, and fastened to a stage fixed on a frame that has a horizontal motion, so as to allow the table to be brought nearer to the rollers, or removed from them to the distance of two inches, and thus afford sufficient room to introduce the leather between the rollers and the table.

A small part of the top and bottom of the table should be gradually eased, or tapered off, that the rollers may come gradually and freely upon the leather, which, with the assistance of a *stop*,

that hinders the table from coming too close to the rollers, prevents the glazing rollers from indenting and injuring the leather, by a sudden and abrupt contact. This stop is fixed on the lower frame that carries the table, and may be moved at pleasure, by means of two screws, so as to determine the minimum distance between the rollers and the table, according to circumstances.

The table is brought up, and kept to the rollers, by the workman pressing upon a treadle, that has the other end of the lever formed into a segment of a circle, cut into cog teeth, that operate on a cog wheel, mounted on an axis, carrying at the same time a wheel, round which a chain is rolled, connected with the frame of the table; so that when the treadle is depressed, the table is brought towards the rollers, with a power equal to eight times the pressure of the workman, deducting the weight of the table and frame. When the workman ceases to press on the treadle, the table is removed from the rollers to the above-mentioned distance of 2 in. by the operation of a counter-weight, fixed to the axis of the treadle by means of a lever.

Mr. Samuel Phelps's *Patent for certain Improvements in manufacturing Soap.—Repert. of Arts, No. 76, Second Series.*

This improvement consists in raising the temperature of the mixture, and keeping up the ebullition by introducing steam into it, through a single pipe, of an inch in diameter, immersed about four feet in the mixture, and opening about one foot from the bottom of the vessel containing it. And to prevent the rising of the mixture from the soap copper into the steam boiler, when the temperature of the latter is lowered, a cock, valve, or other contrivance, is to be interposed between them.

As the introduction of the steam will weaken the lees, an allowance is to be made for it by adding a quantity of strong lees, at the first, or any subsequent time.

Observations.—In our last volume, p. 237, will be found an abridgment of Count Rumford's notice respecting the use of steam in making soap, which is evidently the origin of this patent; Mr. Phelps having only taken, or at least attempted to take, an advantage of the law of patents to secure to himself the method of soap-making, which the Count had given, as it were, to the public. Of the legality of this step, it is for lawyers to decide. The principle of Mr. Phelps's patent has also been suggested in the specification of a patent, granted to Mr. T. S. Wood of Oxford, in the year 1784, published in the fourth volume of the second series of the Repertory of Arts.

Mr. Joseph Jewell's *Patent for a Method of preparing or reducing to an impalpable Powder, for medicinal Use, the Substance commonly called or known by the Name of Calomel, whereby the Process of levigating the same is rendered unnecessary. Dated Nov.* 1807.—*Repert. of Arts, No.* 74, *Second Series.*

The calomel, or mercurius dulcis, is to be sublimed, or driven by heat from an earthen long pot into a receiver luted to it. This receiver is half filled with water, and has *a cover*, "*which cover has a side continued upwards, for containing water, with a chimney or tube in it to allow the escape of steam from water below.*" By this means the calomel is instantly condensed into an impalpable powder, that only requires to be washed over once, to free it from any coarser particles which may form about the mouth of the crucible.

Observations.—This patent, although its general meaning is evident, seems obscurely expressed in that part which relates to the cover. The effect may certainly be obtained by the receiver having an opening with a groove round it, which groove is filled with water, and then the deep ridge of the inferior edge of a cover immersed in the water, the volatilized calomel that is not condensed in the receiver, must pass into the water in the groove, and be there arrested in its progress.

Messrs. Henry *and* Sealy Fourdrinier *and* John Gamble's *Specification of their Inventions for making Paper by means of Machinery, for which several Letters Patent have been obtained at different Periods, and now extended by an Act of Parliament to fifteen Years from* 14 *August* 1807.—*Rep. of Arts, No.* 76, *New Series.*

It is scarcely possible to describe the very complicated machinery included in this specification without figures; but a general idea of it may be gathered from the following short description.

The pulp, having been prepared in the usual manner, brought to the due consistence by the admixture of water, and kept in motion in the vat by means of what are denominated hogs, is let to run through certain circular apertures in the front of the vat, which can be narrowed or widened at pleasure, by means of a sliding plate. The pulp is then conducted by means of a very smooth inclined plate of copper, to the surface of a revolving or endless web, made of wire, felt, &c. which passes over two rollers, and is kept supported by several others, that it may not hang down or bag, but be kept as level as possible. The pulp is kept

within due bounds, according to the width intended to be given to the paper, by two pieces of wood, exactly parallel with each other, and with the line of motion of the web. Each of these rules is about four feet long, and an inch and quarter thick. Between the web itself and these rules are placed two endless straps of leather, as wide as the rules are thick, and revolving with the same velocity as the web, but on different rollers. Similar rules and endless straps are also placed in contact with the lower surface of the web, so that the web is confined between them on each side, and the liquid pulp is prevented from running off on the sides. Near that part of the web upon which the pulp falls from the inclined plane, there is placed a flap of oiled silk, or other material, to prevent the pulp from running back towards the vat.

As the web revolves upon its rollers, and carries along with it the pulp on its upper surface, it passes over a roller of a large diameter, situated at some distance from the vat, and the water is pressed out of the pulp by means of another revolving web, of wove wire or other fit material, which runs over several rollers situated above the under web, and in particular over a roller, of large diameter, placed directly over the lately mentioned roller, of like dimensions, and thus forms an apparatus distinguished by the name of the wet-press. The two endless webs are brought together into contact, and the required pressure given by means of screws, which increase or diminish the distance of the large compressing rollers, and these being covered with flannel, cloth, or felting, are prevented from injuring the webbing, as well as produce a better effect upon the paper than naked cylinders would do.

To prevent the water, thus pressed out of the pulp, from running back upon the pulp, the under web is not only made to descend before it passes the wet-press; but there is also placed a small roller, resting upon a web, as near the press as possible. And some part of the water is previously got rid of by the webs, with the pulp between them passing through a small pair of rollers, to the axis of the upper one of which rollers are hung weights, in order to give a slight pressure.

The water that drains from the pulp is collected in a trough and returned to the vat, by means of a scoop wheel, instead of a pump, which might form the paper stuff into lumps or rolls.

The under web is kept extended laterally by guide wheels, and the shaking, which is so advantageous in making paper, is given by an ingenious contrivance, for which we must refer to the original, in the Number of the Repertory whence this account is taken.

But as the paper, even after having passed between the wet-press, is not of that consistency and strength as would allow of its being removed from the machine, cut in sheets and laid in packs, the new-made paper is made to pass upon another revolving web,

of flannel, felting, or other proper material, which is stretched by two principal rollers and other subordinate ones. By the revolution of this web, which must have the same velocity as the former, the paper is brought between two rollers of brass or other hard metal, which are turned perfectly smooth, and placed at some distance from the wet-press cylinders, but exactly parallel to them, and, after passing through them, is collected and wound upon reels or rollers, which are from time to time removed, and others applied in their room.

The long sheets of paper, thus obtained, are unrolled upon a cutting table, having grooves with steel edges placed at a proper distance, and thus the sheets of the usual sizes are cut by means of steel cutting wheels, running in the grooves of the table, and pressed down upon them by a loaded carriage. The roll of paper is placed parallel to these grooves, which are so much longer than the utmost width of the sheet, as is sufficient to let the carriage be retained on either side, while a sheet is taken off the table, and fresh paper drawn on; in doing which, care is taken to keep the edges of the roll at right angles to the grooves, for which purpose direction lines are drawn upon the table.

Observations.—Considered altogether, we think this one of the most important inventions, as applied to the manufactory of paper, which has been struck out since the fourteenth century, when the method of making paper from rags was first discovered. In general the progress of invention is slow and gradual; but with regard to the fabrication of paper, there have been very few striking improvements, we mean in relation to machinery, for nearly a century. The processes for improving the general texture and appearance of the paper, the more skilful use and application of sizing and hot-pressing, have certainly made some important advances, even in the course of the last twenty years; while, for a much longer period, the modifications in the machinery used for the conversion of rags into pulp and of pulp into paper, have been very slight, and for the most part very unimportant. We have very recently gone over some paper-mills within twenty miles of the metropolis, where we saw some of the finest and most exquisitely textured paper, whether for writing, printing, drawing, or copper-plates, that was ever fabricated; but where all the machinery, except that used in converting rags to pulp, was nearly as rude (we speak in reference to *principle*, not to *appearance*) as it would have been in a Dutch paper-mill of two centuries ago. If we are not mistaking, the most ingenious and useful improvements in the machinery have been published since the commencement of this work; and our readers may find descriptions of them, with an appreciation of their excellencies and defects, in our first and second volumes. In the second volume, we

pointed out what appeared to us to require modification in Mr. Fourdrinier's contrivances: the specification, of which we have just given an account, has removed the most forcible of our objections: and, although we think the machinery now proposed, in some cases, a little too complex, yet on the whole it is extremely ingenious, and appears well calculated to answer the purposes for which the patentees proposed it. Our principal objection now, is to the contrivance for cutting the sheets, which, though doubtless preferable to the means before suggested for the same end, is still liable to some very obvious evils, which are sufficiently apparent, and which we have no doubt the patentees will soon discover and correct.

We conclude with just hinting the importance, in the present state of our political relations, and the extreme difficulty of obtaining rags, of directing the attention to other substances from which this valuable article may be fabricated. Silk, it is well known, has been used in the East, as long ago as the seventh century; but the article is too expensive for general adoption. Cotton, when treated in a manner similar to that practised with linen rags, affords an excellent paper, which at present forms a very extensive branch of the Levant trade. The Japanase paper is, according to Kempfer, made of the bark of the *morus papifera sativa*, or true paper-tree. Other substances are, the pith of thistles, the bark of the sallow *(salix capreata)*, hemp, shaws of hemp, shaws of flax, hop-bines, stalks of cabbage, of mallow, of common broom, of the sun-flower *(helianthus annuus)*, of mugwort, of clematis, &c., the down of the cat's tail, the catkins of the white poplar, the husk of maize, straw, &c. Trials of some of these, and especially of *straw*, have been made in England, as far back as the year 1799: but much remains to be done, and as the occasion is important, especially as it relates to commerce and to the promulgation of arts and sciences, we should be happy to find that some public-spirited individual of enterprise and talent would turn his attention to an extensive series of experiments directed to this purpose.

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RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL,

CHEMICAL AND AGRICULTURAL

DISCOVERIES.

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AGRICULTURE.

On Planting and waste Lands.—By the Bishop of LLANDAFF *(Rich. Watson, D. D.)—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THIS communication of the Reverend Prelate relates more particularly to the improvement of waste lands, by planting them with larch-trees. He states that he purchased a few years ago a tract of land in Cartmell Fell, in Westmorland, consisting of 499 acres, one hundred and twenty of the best of which he fenced off in divisions, and built on them a small farm-house; and planted the remaining 379 acres with larches where the ground would permit, at six feet distance from each other, which required twelve hundred and ten plants to the acre; a small part was planted with Scotch firs, and part yet remains unplanted, which consists of peat-moss, and moist land unfit for the growth of larches. This part of the land would have admitted of draining, but he forbore that expense because he has entertained the design of converting the whole into pasture again for sheep at the end of ten years, when he expects the larches will be quite out of the reach of sheep, and the pasture so much improved by the shelter which the trees will afford in every direction, and by the augmentation of the soil received from the annual rotting of the spontaneous produce, and the leaves of the trees, that it will be as valuable for sheep as before it was planted. This idea is not advanced on mere hypothesis, for his Lordship had many years since made a plantation of forty-eight thousand larches near Ambleside, and has for some years let it for a greater rent as a sheep pasture, than he could have had for it before it was planted, and the trees are not in the

slightest degree injured by the sheep. This is said to have been the first experiment made in Westmorland of planting the high grounds with larches, a general opinion prevailing there that no tree would in that situation arrive at the size of a knife-haft; many trees, however, of this plantation made in 1788, are from fourteen to eighteen inches in circumference at six feet from the ground: thirty thousand Scotch firs had been planted at the same time on the same mountain, but at a distance from the larches, which made good shoots for the first six or eight years, but then began to decay, and are now all perished. He does not, however, venture to assert from this single fact, that larches will flourish on mountains and exposed situations where Scotch firs will perish, for there might be other causes for this failure of the firs besides the height and exposure of the situation; indeed he suspected that the substratum was an impenetrable gravel, composed of fragments of whinstone, quartz, and clay, which destroyed the roots of the firs, by obstructing the descent of the wet, while the larches were preserved in consequence of their roots running horizontally: with this notice of the fact, he leaves the causes of it to future investigation.

Though the Bishop had experienced such bad success with his fir plantations at Ambleside, he ventured to plant 30,000 on his new plantation on Cartmell, with a view of sheltering the future pasture, and from an expectation that, if they all died, the land would be much improved by the rotting of the leaves before it was again reconverted into sheep-pasture; and if they lived, they would afford shelter to the other plantations, and their boughs give excellent food for sheep in severe weather. The mountain on which these plantations are made, is very rocky, producing only strong ling, and the elevation very great. It is observed that if the larches on the top and sides of this mountain should thrive, the success will render future planters less solicitous about shelter for this plant; and if they should fail, the want of success will not be without its use as a warning to others.

Part of the larch plants were raised by the Bishop in his own garden, and the rest furnished by nursery-men; they were from twelve to twenty-four inches in height, and cost, when laid on the land, carriage and package included, twenty-two shillings a thousand, and eight shillings more a thousand was paid for planting. The whole sum expended in planting 322,500 larches at 30*s.* a thousand, amounted to 483*l.* 15*s.* exclusive of fencing the plantation, the expense of which is not taken into the account, because the ground must have been fenced, whether it had been planted or not.

It is next stated that if £483 be improved at the compound interest of £5 *per cent.* it will amount in sixty years to £9021, to which may be added ten years rent of the land at half a crown an acre, which would amount to £519, making the whole

expense of the larch plantation at the end of sixty years, amount to £9612; and it is asserted that, according to the lowest received growth of larches, if one half of the trees be cut down at the end of twenty years, one half of the remainder at the end of forty years, and the rest at the end of sixty years, the produce, upon the most moderate computation, would amount to one hundred and fifty thousand pounds, if the commerce of the country and the price of foreign fir wood continue for sixty years without diminution.

At the time the venerable Prelate prefixed some preliminary observations to an agricultural survey of Westmorland by Mr. Pringle, he asserted that the annual increase of the larch-tree in circumference at six feet from the ground, is one inch and a half on an average of several years; but the subsequent admeasurement of many single trees, as well as of portions of plantations, incline him to believe that these trees do not, at six feet from the ground, increase above half an inch: many of these admeasurements are particularly described.

The improvement of the larch is, however, found to be very variable in different situations; an acre of larches near Winandermere being worth, at 17 years growth, 101*l.* 15*s.* 6*d.* while an acre at Ewanrigg, of 24 years growth, was worth only 82*l.* 15*s.*; the wood in both cases being measured and estimated at ten-pence the foot; but as there is a considerable quantity of land both in Great Britain and Ireland, of very little value in its present state, and which cannot be converted into arable land; this, by being planted with larches, is stated to give a rent immediately of above thirty shillings a year for every acre; for an acre of larches at 24 years growth on but indifferent land, is worth £100, and the present value of £100 to be received twenty-four years hence, is £31, which will produce 31*s.* a year; and this may be considered the immediate rent of the land planted with this species of fir.

These details are given with much minuteness, with the avowed intention "of animating the proprietors of large portions of waste land (for small portions are fenced at too great an expense) to benefit themselves or their posterity, and to promote the public welfare, by planting them with larches. One would wish," says the writer, "on the public account, to plant oaks instead of larches, and in some sheltered spots this may perhaps be done, even in high situations, with private emolument." His experience however, and he has planted many thousand oaks, ashes, beeches, elms, and poplars, on a mountain near Ambleside, does not induce him to recommend the planting of land so situated with any sort of tree except larches; for though the oaks planted by him sixteen years ago, are mostly alive, yet they are mere shrubs, with stems as thick as a man's wrist, the summer shoots being ge-

nerally destroyed by the frost in winter; and all the other sort of trees have disappeared entirely.

Another mode is pointed out of turning a plantation of larches to profit, which may in some cases be considered preferable to reconverting the plantation into a sheep-pasture, and that is by cutting down the whole at twenty or thirty years growth, and replanting the land; but there is considerable doubt whether any subsequent crop would be as valuable as the first.

Many very important and valuable observations are subjoined, which it is unnecessary to notice, as they relate more particularly to political economy. One remark, however, must not be passed over. "It has been frequently remarked," says the Bishop, "that we have not of late years grown corn enough for our own consumption, though fifty years ago we had a copious exportation of it. Unless our waste lands are extensively brought into cultivation, the deficiency between our growth and our consumption of corn will annually increase; for the causes of this deficiency are not likely either to continue stationary, or to become lessened. These causes are principally three: the increase in the number of the people; the increase in the consumption of butcher's meat, by which much arable land is converted into grazing land; and the increase in the number of horses kept for war, for husbandry, and conveyance of goods, and for pleasure. I consider this last cause (the number of horses) to be the most important of the three, and equal perhaps to the other two. We have no means of knowing the number of horses which were kept in Great Britain forty years ago; but supposing that only one hundred thousand more horses (about an eleventh part of what now pay the duty) are kept at present than were kept in the year 1766, this additional number will consume in hay and corn the produce of a quantity of land, which, if cropped with bread-corn, would supply bread to a million, if not to a million and a half of men for a whole year. This cause of the deficiency of our bread-corn will continue to increase, not only with the increase of our luxury in the use of carriage and saddle horses, but with the increase also of our husbandry, and of our trade foreign and domestic, unless the use of oxen for draught should become more common than it has ever been in this country, or canals should become general."

The communication concludes by a statement of the improving of about 200 acres of waste land at Kelleth, in the parish of Orton in Westmorland. The mode pursued did not materially differ from what has been frequently detailed in books of agriculture: it in general consisted of paring, burning, ploughing, liming, and sowing with turnips, and afterwards with grass-seeds natural and artificial, with or without a crop of oats, though a preference is given to sowing the seed without grain of any kind. The land was covered with ling, and was of the value of only eighteen pence an acre, but some of it is now let for a guinea, and the

whole might be for fifteen shillings. The expense of improving was eight pounds an acre. Lime is considered essential to the improvement of this sort of land, but as lime cannot be procured in every neighbourhood, nor be conveyed to very high situations, except on the backs of horses, it is recommended to offer a premium for the improvement of such land without lime; and it is suggested that not only in Westmorland, but also in Wales and Cornwall, there are millions of tons of refuse slate-metal, which might answer the purpose of extirpating the ling; and even volcanic ashes, decayed leaves, decomposed schist, and the shiver of all other argillaceous and siliceous stones, might answer the same ends; and the ling and fern growing on the sides of mountains might be destroyed by making the water flow over them in little cascades in its descent, and in a few years the finest pasturage might be produced by this species of irrigation.

Observations.—It is impossible to contemplate, without internal satisfaction, the literary leisure and declining years of this learned Bishop employed in improving the useless acres which yet disfigure so large a portion of the soil of our country, and in procuring future blessings to the nation to which he belongs. That such is his occupation, and that such are his motives, is evinced by the preceding communication of the venerable Bishop of Llandaff to the Board of Agriculture. And when it is recollected that the facts and opinions there detailed, rest on the authority of the author of "Essays on Chemistry," it would be superfluous to enforce them by our recommendation. At the same time we take leave to remark that the attempt to plant the very tops of our most barren mountains with that useful species of fir timber, the larch, is entitled to our gratitude, and calls for our imitation. When the oak is year after year becoming more and more scarce, it must be of increasing importance to naturalize to our soil, a wood which will be equally useful to the builder in many particulars, especially in long beams, and roofs, where neither ash nor elm can be applied, because they will not long preserve their linear position. The practicability of raising the larch on soils where nothing else will grow, is fully established by the experiments of Bishop Watson, and the profit to be derived from the planting this species of fir, is too clearly made out to be mere matter of speculation. Nor do the failures recorded in this paper afford instruction less useful, than the successful experiments; for when plantations of ash, elm, and beech on lofty mountainous situations entirely failed under the care of this experienced planter; and oaks, which had been raised from the acorn with the greatest care, became miserable stunted shrubs, it would be worse than folly to repeat the trial on similar soils and elevations. This communication also affords the useful information that the larch will thrive where the Scotch fir perishes, on ac-

count of the former extending its roots horizontally, while those of the latter endeavour to penetrate deeply into the ground. This will teach us what to plant on rocky places where there is little depth of soil, without incurring the risk of disappointment. The suggestion of converting planted grounds again into a sheep-walk after the trees have grown beyond the reach of the sheep, we believe to be now recommended from the press for the first time; but the practice has obtained for some years near Woburn, in Bedfordshire, in the plantations of the Duke of Bedford and Col. Moore, though we think the sheep were not admitted at so early a period as ten years after the time of planting. These plantation sheep-walks are superior in the quality of the grasses, to the uncultivated adjoining hills, but do not produce an equal quantity of food. The suggestions respecting the application of slate-chips and the refuse of stone-quarries to the improvement of waste lands, is equally applicable to the rabbit-warrens of Norfolk, and the wastes of Hampshire, as to the neighbourhood in which the Bishop resides. In a word;—the whole article cannot be read without advantage by the proprietors of waste lands, of the nature and in the situation described.

On the Culture of Flax. By the late ROBERT SOMERVILLE, *Esq. of Haddington, in East Lothian.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

SINCE flax and hemp are articles so essentially necessary to the British kingdoms, the very limited cultivation and defective management of these plants is much regretted by the writer; for he is of opinion that the accomplishment of an object so truly desirable would be attended with the most salutary effects, by affording employment for an increased population, and materially lessening our dependence upon other nations. Impressed with this idea, he thought it might be useful to give a general sketch of the present mode of cultivating and managing flax, and to enter into a detail of the principal operations, pointing out what appears defective in each, and suggesting hints for improvement.

It is asserted that flax is cultivated at present without attention to any regular system, and upon a very contracted scale; and though it is not contended that in the present state of Britain, with regard to provisions and population, it might be expedient to apply much of the arable lands, now cultivated for grain, for the growth of flax, yet there are at present immense tracts under the denomination of moors, mosses, swamps, &c. upon which hemp and flax might be successfully raised with little labour and expense; but likewise the tillage and culture necessary for this purpose would considerably facilitate their further improvement;

for it is well known to those who have had experience in raising flax on similar soils, that it may be done, not only with safety, but advantage; but much land of this kind lies in a state of nature from a fear of the expenses to be incurred in the improvement. Flax, however, requires no expensive preparation; tillage alone and the cost of the seed being all that are necessary; and the crop will not only repay these, but will generally afford a profit sufficient to purchase manure for future crops.

Notice is taken of a former publication by the Board, in which is pointed out the ease with which potatoes may be resorted to as an introductory crop for the improvement of wastes, and it is contended that flax may be used for that purpose with equal advantage; since neither of them require any expense except seed and tillage. The importance of the cultivation of flax is strenuously insisted on, even if the produce were confined merely to supplying ourselves; but it is doubted whether the practice might not be carried farther, and Britain become able to rival Holland in supplying other nations, since the soil of our own country is as fertile, and the climate as genial as that of Holland or the provinces on the shores of the Baltic.

The cultivation of flax is believed to be laid aside by the more opulent farmers, from an idea of its exhausting quality, and to be principally in the hands of the poorer tenants and cottagers, especially in Scotland, and consequently the quantity raised is comparatively very small.

The SEED also, from which this small quantity is raised, is annually imported either from Holland or the Baltic, from an erroneous opinion that after seed has been once sown in this country it becomes unfit for the purpose afterwards. It is not pretended to determine from whence this idea originated, but it is admitted that the Dutch, who had long been in possession of the trade, and had arrived at a higher degree of perfection in the management of it, were enabled to dress the seed much better than we are, and to bring it into the market at the cheapest rate; and it is intimated that the Hollanders themselves first propagated the opinion that flax-seed raised in Britain was inferior to their own.

It is conceded that where the crop is cultivated solely for the sake of the flax, it is usually separated from the ground at a period when the seed has made little progress in ripening, and such of course is unfit for the purposes of sowing; and while this practice continues, an annual supply must be regularly obtained: but one object of this communication is to shew that, with proper management, and without additional expense, the advantages of well-ripened seed and a valuable crop of flax may be easily united; and this idea is represented to be not visionary, since it is done in Holland and on the shores of the Baltic regularly every year, and the whitest, most durable, and easiest bleached flax, produced

in those parts, is stated to be from crops completely ripened. The argument, that, where the seed is ripened, not only the flax is worse, but the soil is more impoverished, is admitted to be plausible, and would be well founded if the flax was pulled while it was in flower; but when it is considered that at the usual time of pulling, the seed is not only formed, but has made very considerable progress, it is insisted that it will appear on inquiry, that the crop has, in that stage, drawn as much oil and useful principles from the earth as it possibly can do; for though the seed at that period contains less oil than it does when completely ripened, yet the deficiency will be found in the stalk in the form of a mucilage. "If," it is said, "this reasoning be sustained, the exhaustion of the soil must be the same in both cases;" and, in the opinion of this writer, the mucilage remaining in the stalk in green flax, is the principal obstacle to the separation of the flax from the stalk. The opinion that the flax is of a coarser quality when the seed is allowed to ripen, is treated as a popular error; and it is further asserted that the ripening of the seed may not only be attempted with perfect safety, but that the flax will be whiter, and every operation of its manufacture facilitated in consequence. Referring this argument to the succeeding part of the essay, the point insisted on here is—"that *flax-seed of the best quality may be raised in Britain without injuring the flax, or exhausting the soil more than is commonly done for crops where the flax is pulled green.*"

The PRESENT MODE OF CULTURE, AND AFTER-TREATMENT OF FLAX, is next discussed; and it is stated that, whether cultivated by small farmers or cottagers, it is sown upon what is termed run-out land, the year before it is to be fallowed; of course the soil is poor, and the crop bad in proportion: if injury arises to arable land from being sown with flax, when the soil is clean and in good heart, the mischief done must be beyond expression, when it is sown after the soil is exhausted by repeated corn crops; for it being a settled principle with the growers of flax to pulverize the ground as perfectly as possible, much risk is said to be thereby incurred, for "great damage," says Mr, Somerville, "is sustained when the soil is too much pulverized." It is recommended therefore, whatever be the nature of the soil upon which flax is sown, that a pretty round clod be left upon it, if possible, but strong clays are not conceived to be a proper soil on which to sow it at all; if, however, it be sown upon a clay, the leaving a pretty round mould upon it, will not only prevent it from battering or consolidating, but will, at the same time, allow the roots to stretch themselves out in quest of food: loam also, and all light soils, preserve their moisture much longer if left in a rough state, than when they are made very fine; and more danger is to be apprehended to flax in a dry than in a wet season; and the common objection to leaving the land in this state, that the crop

does not come up equally where the surface is rough, is held unworthy of attention.

Having made these remarks on the defective mode of preparing land for flax crops, he proceeds to assert, that the whole, or the greater part, of the subsequent operations, are equally defective. He observes, that the expense of weeding flax, when sown on worn-out land, is enormous, and the crop is injured at the same time, for the first weeding is generally given when the plants are too tender to bear much pressure; of course, many of them are trodden down and destroyed by the weeders, and, at the time the second weeding is given, the flax has often made such progress, that the stalks are in danger of being broken down, a circumstance equally destructive of the crop, for the broken stalks will not ripen at the same time with the others; and, consequently, the produce is lost: no weeding ought to be attempted till the flax be four or five inches high, when the weeds may be easily pulled without much damage, provided the weeders stand constantly upon their feet, and perform the work stooping.

The present METHOD AND TIME OF PULLING FLAX are stated to be, while the stalks are quite green and full of sap, and by grasping the stalks indiscriminately about the middle: the pulling it at this stage of growth is censured; inasmuch as the seed, though formed, and of its full size, has not acquired the firmness or vigour that is necessary to render it fit for sowing, and this mode of doing it does not admit of a separation of the different qualities.

When the pulling is finished, the next operation consists in SEPARATING THE SEED FROM THE GREEN FLAX, which is performed by drawing it repeatedly through a coarse heckle, and in Scotland it is termed *rippling*.

After the seeds are separated in this manner, the flax is bound up in sheaves, and WATERED, as the term is, by putting it into water, with large stones upon it, to prevent it from rising to the surface, either in pools, or small streams of running water; and when it is supposed to be sufficiently watered, it is taken out, and either dried immediately, or spread upon newly mown grass, and allowed to remain there for some time; after which, it is gathered into sheaves and taken home, till wanted for the manufacturer.

BREAKING AND SCUTCHING are the next operations; the breaking was formerly performed by beating the flax with a long round piece of wood, and afterwards strongly rubbing it between the hands to separate the husk as much as possible, though a hand machine is now generally used for this purpose; and the scutching is still performed in the old way of laying the flax over the edge of a plank in handfuls, and striking it with a piece of wood resembling a sword. After this it is HECKLED, or combed.

Mr. Somerville having thus dismissed his account of the manner in which flax is, at present, cultivated in his native district of

East Lothian, proceeds to remark on the nature and preparation of the soil for flax; the time of sowing; the pulling; the watering; the steeping; the scutching; and the heckling.

Nature and Preparation of the Soil.—It being taken for granted that an extended culture of flax, and that applying good arable land for that purpose, might be productive of mischief, by enhancing the price of grain; it is inferred, that the principal benefit to arise from an extended cultivation of either hemp or flax, is only to be expected from sowing it upon such lands as are, at present, of little or no value to the community; and the kinds of waste land thought to be best adapted to this crop, are mossy, miry, and soft, black, inactive, loamy soils. The only preparation conceived to be necessary is, to plough them early in the spring with a paring plough, which will completely invert the sod, and turn the roots to the sun; and to permit the land to remain in this state till the following spring, when it should be first ploughed across, then completely harrowed, and afterwards ploughed in the direction of the ridges, after which, the soil will be in a proper state to receive the seed. Three ploughings, then, two harrowings, and the expense of seed, are all that is necessary to put waste lands in a state to yield valuable crops of flax; except, perhaps, where the surface may be covered with benty grass, or strong heath, in which, burning may be necessary. It is, however, suggested to proprietors commencing their improvements of this kind, that the soil will be reduced, and the herbage rotted more perfectly by giving the land a two years' fallow, and two additional ploughings, and a cross harrowing after each: since, by such management, if the field be laid dry, every particle of the vegetable substances, which formerly grew upon the surface, will be rotted and converted into manure: and, though all this may, in general, be done in one year, yet it may be more effectually accomplished in two; and, if cottagers cannot wait three years for a return to their labour, it is recommended to more opulent proprietors to do so.

Time of sowing Flax.—Though flax is seldom sown till the end of April, or the beginning of May, when the soil is dry, yet it is contended, that it might be more advantageously sown in March, as it would be then so far advanced before the setting in of the warm weather, that there would be very little danger of its being hurt by drought; and even were the summer ever so moist, it would be fit for pulling at so early a period of the season, that the management of it could not possibly interfere with the harvest: another advantage too, would be found from the weeding happening in the interval between seed-time and hay-harvest, and the pulling between the hay and the corn harvest; and, besides this, the length of days at that season, together with the light and heat, would contribute to render the watering, and other operations, more effectual than they can possibly be, at a very advanced part of the season. It is observed, that flax is, at present, sown very

thick, that the greater number of plants may smother the weeds, as that a thick crop of flax, by growing smaller in the stalk, is always of a finer quality than that which is sown thinner. The first of these ideas is admitted to be well founded, and in the case of worn-out lands to be highly necessary, for when flax is sown thick and vegetates freely, it will so entirely cover the surface, as to prevent the growth of weeds; but, with regard to the flax being of a finer quality, the matter is held to be extremely questionable, and the writer rather inclines to the opinion, that the quality will be injured thereby, and the crop produced, by being so thick, and deprived of the light and air, will, in general, be soft and weak, and of a quality ill calculated for the ordinary purposes of wear. He is aware that many maintain the opinion that the finest flax is produced by the smallest stalk, but he conceives that they have mistaken softness and weakness for fineness, and he is satisfied from more than one experiment, that the strongest stalks, under proper management, will produce the best and most durable flax; and even though, by sowing thin, the flax may become forked, in which case the flax is not so good, yet it will in general grow so much taller, as will more than compensate any loss sustained by the forking. He has, however, been always sceptical on this point, and from several experiments made upon a given number of forked and unforked stalks, the result of all of them was, that the forked stalks produced as much flax as those that were not forked, with this difference, that the flax from the forked stalks was plumper at the end, and weighed heavier than that which was not forked; for the obvious reason, that the flax which forms the covering of these branches, instead of originating where the branches begin, is a continuation of the covering of the main stalk, and when freed from the inner husk, forms one entire length with the whole stalk; it is, however, confessed that the flax from the forked stalks is more difficult to manage in the dressing than where it is not forked.

Pulling of Flax.—The usual way of pulling flax by grasping it in handfuls near the middle, is considered to be highly objectionable, for by this mode the whole produce, long and short, is pulled at once, and many weeds along with it, which very materially affects the dressing; and where the whole crop is pulled in this manner, much loss is sustained in the subsequent operations, for much of the short flax is lost in stripping off the seed, and what escapes that operation is wasted or lost in scutching or heckling. In place of the above practice, he would recommend that the person who pulls the flax, instead of grasping it with the hand near the middle, should lay hold of it by the top, and pull up the longest stalks at the first pull; these long stalks should be laid aside by themselves: the puller should then lay hold of the stalks next in length, pulling and laying them by in the same manner; and so on till the whole crop is pulled; by which method flax of three or four different lengths may be obtained in every field; and

in consequence of such a previous assortment, very little would be lost in the subsequent operations of rippling, scutching, and heckling; for when flax is properly sorted, even the shortest may, with good management, be dressed in such a manner as to render it highly valuable.

Watering of Flax.—When the flax is pulled, and the seed separated, it is put into water; and this is represented to be one of the most important operations which flax undergoes, and the writer deems it necessary to enter minutely into its effects; and as the steeping in stagnant or running water differs materially, to notice them separately. Green flax is said to contain much oil, and this is taken as going a great way to prove that the mucilage in green flax is convertible into oil, and that in the process of ripening, nearly the whole of it would be lodged in the seed; for while the crop is green, the filaments of the flax are kept firmly united, not only to the stalk, but to each other, by means of these mucilaginous juices; and to dissolve these properly so as to permit the flax to split into as fine filaments as possible, and at the same time to wash out the colouring matter, and render its separation from the husk more easy, is the purpose of watering.

With respect to *steeping in stagnant water* it is observed, that if the flax be suffered to remain there for any considerable time, and the weather be warm and the water free of mineral impregnations, putrefaction takes place, the effect produced by which is upon the juices of the flax, which soon partake of the putridity, and then the putrefaction extends itself to the husk, and even to the flax itself; on which account the custom of watering flax in stagnant water is liable to considerable risk, for if it remains too long, there is a chance of its being partially or wholly rotted: besides, stagnant water is of itself thick and gross, and will be found, in warm weather, to be loaded with earth and other impurities, and "plain sense will readily discover," says Mr. Somerville, "that water so loaded with earth and other impurities, will be very unfit for dissolving or washing out the mucilage or colouring matter of flax:" for, though the putrefaction which takes place will decompose the principles contained in the stalk, yet, from the heavy and impure nature of the water, it will be found incapable of suspending or washing out the juices so decomposed, by which means they remain upon the flax, and as the water is daily growing thicker, the flax becomes more tinged of a blue or black colour. It is also asserted, that the custom of laying the sheaves in heaps for a day or two, after they are taken out of the water, is attended with more danger, since the putrefaction which has commenced will be continually increased while the flax lies in heaps; though it is freely admitted, that where the flax has been but a short time steeped, and it is believed that the juices are not sufficiently softened to admit of an easy separation, the business may be accelerated by allowing it to remain bound up for some

time after it is taken out of the water; and, in such a case, a small degree of fermentation will be highly useful, but the process ought to be managed with much caution. The practice of drying and housing the flax after it is taken out of stagnant water, is spoken of as attended with very bad effects; for not only the whole of the mucilage, colouring matter, &c. remain upon it, but also a considerable portion of the earth deposited by the water; and this earth and dirt mixing with the mucilage harden and form a cement, which creates a strong adhesion between the flax and the stalk, that occasions a loss in the dressing, and renders the quality worse by preventing it from splitting into filaments sufficiently fine. In whatever way the flax may be disposed of afterwards, it is recommended to open the sheaves immediately on taking them out of the stagnant pool, to separate them into small handfuls, and completely rinse them in pure running water, as this operation will wash off much of the filth and dirt, and improve both the colour and the quality.

Steeping flax in running water is said to make it of a whiter colour, and softer than when steeped in stagnant water, and it is at the same time stronger and more durable. This difference is accounted for, by noticing that the stream of water perpetually passing over the flax, not only keeps it so cool as to prevent it from rotting, but also carries off the mucilage and colouring matter as fast as it is disengaged. It is conceived that the long steeping usually given to flax, will, upon inquiry, be found unnecessary; but while the custom of steeping still prevails, it is suggested that the sheaves, into which the flax is generally bound, are much too large to admit of the water penetrating them properly, and that the smaller they are, the more complete and speedy will be the operation of the water upon them, and the shorter will be the time requisite for steeping: for however small the sheaves may be, some glutinous matter will, on opening them, be found entangled among the stalks; and to disengage this, it becomes necessary to open, separate, and rinse them in running water, and a still greater quantity might be disengaged if they were afterwards dipped in boiling water. But from some trials which he has made upon a small scale, the writer advises that, previously to the flax being steeped at all, it be dipped by handfuls in boiling water, in which a quantity of good potash has been dissolved, and then tied in bundles of three or four handfuls only, and put into the water to be steeped. The effect of the boiling water will soon become apparent by the speedy discolouring of the steeping water, which will assume a brown appearance for twelve or fourteen days, from which time the water will become gradually clear and free from tinge, and when this takes place it may be regarded as a certain proof, that the flax has been sufficiently watered. This, however, is thought not to supersede the necessity of opening the sheaves to

rinse them in the stream, and afterwards dip them in boiling water; and though the spreading to dry may appear simple and unimportant, yet, as this is intended for a kind of bleaching, much will depend on the nature of the ground, for if it be dry and no rain fall, the flax will receive but little benefit from being laid out. It is added, that those who are conversant in such matters, know that bleaching consists in dissolving and separating the oil, mucilage, and colouring matter contained in the cloth; and the slightest observation is said to be sufficient to convince every intelligent man that these operations are less injurious to the flax, when applied in an unmanufactured than in a manufactured state.

Skutching of Flax.—As this operation is, perhaps, the most severe which flax has to undergo, Mr. Somerville advises to pass the flax between fluted rollers, to break the husk as much as possible, which greatly facilitates the operation, and prevents a considerable portion from being destroyed. And the difference in value between that scutched at home, and the flax which is dressed at a mill, is said to be almost inconceivable; for the mill renders the flax finer, and obtains the greater quantity from the raw material, and the operation is performed at one third of the expense of dressing by hand.

Heckling of Flax.—The manner in which this operation is performed is treated with unqualified censure. Instead of the heckles through which it is put being so few, and the handfuls so large; to do justice to the flax, it is represented that it should pass through six or seven heckles of different degrees of fineness, one after the other, and the quantity taken into the hand by the workman should be particularly attended to; for if it be too large, he will not be able to hold it sufficiently firm to prevent part of it from slipping through his fingers; but if the quantity taken at once be small, the workman will have a complete command over it, so that none be converted into refuse.

The communication concludes with remarking that a part of the proposed improvements in the culture of flax are founded upon experiment, and the remainder the result of observations made at different times. The author expresses his regret that these observations and experiments were not made with more accuracy, but they were not made with a view to publication; and he subjoins a list of points which he deems most worthy of minute investigation in future attempts to cultivate hemp and flax.

Observations.—It is much to be lamented that the sensible recommendations contained in this communication do not come supported by the infallible test of experiment, so as to appear consonant to reason, to philosophy, and to chemistry. As far, however, as Mr. Somerville avows his inferences to be drawn from experiment, he may be safely followed by future cultivators of hemp

and flax. The preparation pointed out comes strongly recommended by its simplicity and cheapness, and the arguments adduced against applying worn-out land to this purpose must be perfectly satisfactory. The reason given for committing the seed to the ground six weeks earlier than is usually done, combines too many advantages, and incurs too few risks, to be neglected by the intelligent agriculturist, and the remarks on weeding the crop will be found practically useful. The mode of pulling and watering are equally calculated to make the best of the whole produce, and to supply the market with a superior article of manufacture. And the want of attention at present to the scutching and heckling, or combing, the flax, may be obviated, in a great degree, by attending to the suggestions on those points. And though we cannot recommend an inconsiderate departure from the established mode of cultivating any plant whatever, yet the reasons here given for an improved culture of hemp and flax are so cogent, that they cannot be attended to by the future grower without profit to himself, and advantage to his country.

On soiling Cattle. By John Christian Curwen, *Esq. M.P.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

This communication is the result of an experiment made on soiling work horses and milch cows from the month of June to the end of September. The quantity of ground appropriated to this purpose was eighteen acres of clover and rye-grass, and six acres of lucerne, together with a pasture of two acres and a half for turning the cattle into during the night. The first crop of lucerne, which averaged six tons to an acre, had been cut previous to the commencement of the experiment, and had been top-dressed with coal-ashes and street-rakings, with a small proportion of lime. The experiment commenced on the first day of June, and the stock to be soiled consisted of eighty work horses, ten milch, and twenty calving cows; to the last, only one stone each of clover was allowed, and the remainder of their food was grass cut from hedges, headlands, and plantations; ten stone of clover per day was also given to pigs, so that the daily consumption of clover amounted to 390 stones, being rather more than the produce of a rood of the first crop. The weight of the green food eaten in the 24 hours by work horses, having an allowance of from eight to ten pounds of oats in a day, was, at first, nearly four stones each, but after the first few weeks, three stone and a half were found sufficient. Milch cows required, on an average, four stones, with little variation. The clover and rye-grass yielded nine tons per acre at the first cutting; the average being ascertained by taking ten square yards in three or four different parts of the field.

For the information of future agriculturists, Mr. Curwen very candidly states an error he fell into in proportioning his cattle to his crop; in a few weeks he was apprised, that not above half of the crop could be consumed in soiling, before a great part of the remainder would become seeded and spoiled; to prevent this, he caused eight acres of it to be cut and made into hay; but as this operation was much delayed by bad weather, the delay was very injurious to the succeeding crop. This inconvenience, he conceives, might have been avoided by cutting one half of the clover for hay at the commencement of the soiling, as much additional time would then have been given between the first and second cutting of the crop. In consequence of the mismanagement alluded to, Mr. Curwen found his second crop of clover over the whole eighteen acres, only six tons.

The grass from headlands, &c. being all consumed by the 20th July, and a sufficient supply for soiling all the stock not being attainable, the calving cows were turned out to pasture, but they had scarcely been out a month, when they were attacked by the gorget, which made it necessary to take them up again, and this occasioned such a scarcity of green food, that the third crop of clover was unavoidably cut in a premature state, and consequently with great loss; to meet the deficiency thus occasioned, forty horses were turned upon the aftermath every evening after work, which produced a saving of from seventy to eighty tons a day. The third crop of lucerne produced four tons per acre, and the third crop of clover, where it had been cut first, produced eight tons and a half per acre. The condition, both of the horses and the cattle, was highly satisfactory, and the writer is not only convinced of the superiority of soiling over grazing, but also is of opinion, that the horses could not have performed their work better, had they been fed on hard meat.

Whenever the weather was favourable, the milch cows were turned out during the night, and taken up very early in the morning, by which means, the gorget was almost entirely avoided, notwithstanding the prevalence of that disease in the northern counties.

In November the lucerne afforded a fourth crop, of nearly two tons to the acre, which together with what remained of the clover, and the tops of eight acres of carrots, fed the stock till the middle of the month. At the commencement of October the experiment was concluded. An accurate account of the various expenses and receipts is added, as well as a comparative account of grazing; from which it appears, that while the profit on grazing is only 1*l.* 10*s.* 4*d.* an acre, the profit by soiling is raised to 14*l.* 9*s.* 7*d.*

It is likewise contended that the profit of soiling is not confined to this statement, but that one most important object, both to individuals and to the public, is the saving of ground, which affords to individuals the means of keeping large stocks near populous

towns, where an extent of pasture could not be procured, and the public at large are benefited by the surplus of land left applicable to the supply of other necessaries; and where farmers have no adventitious resources of procuring manure, it affords a mean of more extensive cultivation, than can be otherwise obtained; and under every circumstance, and in every point of view of the subject, it appears, to the writer, to be the most lucrative and beneficial system which can be followed, and has wherewith to render it applicable and advantageous to all situations.

The communication concludes with an account of crops that followed on the same land which had been applied to soiling, and the quantity of produce clearly proved that the land had not been injured by the application.

Observations.—We have in our former Numbers had occasion to notice from the Communications to the Board of Agriculture, more than one series of experiments conducted by this intelligent legislator, relative to the soiling of cattle. But the present paper seems entitled to higher commendation than the preceding articles by the same writer, because it is more practically useful, inasmuch as it points out a want of success in an important point, and, at the same time, explains the cause of the failure. Whenever soiling is entered upon as a system, it is of the first importance to be able to apportion the stock to the quantity of green food, and on the other hand, to provide a proper succession of green food for the number of cattle intended to be maintained in this way. The accuracy of Mr. Curwen is too well established to need our testimony in its favour, and his data may be very confidently relied on by other agriculturists, who are disposed to follow his plans. The quantity of manure obtained by soiling, ought uniformly to recommend the practice on poor arable farms.

On stall-feeding Cows during the Summer. By JOHN COLLET, *Esq. of Ullevold, near Christiana, in Norway.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THIS communication is from an intelligent foreigner, respecting the management of his estate in Norway. Mr. Collet took possession of his farm of Ullevold, about two miles from Christiana, in the autumn of 1793; of this extensive tract only 150 acres were arable, and those in the most uncultivated state; he could not at that time feed more than three horses and five cows. This restriction of his powers induced him directly to form a plan for a more extensive cultivation; accordingly in the following year he began to trench the ground with large ditches, applying the stones that were dug out for fences and covering drains; the

brambles and shrubs were taken up by the roots, and in two years 390 acres were prepared for cultivation. His next object was to find manure for the land; he made composts of turf, lime, rotten herrings, and the small quantity of dung he could collect; but it served only to procure deeper soil without giving proper nourishment; at length he found marl, and applied that; and having begun to cultivate clover in 1796, he determined on stall-feeding his cows, as the most effectual method of obtaining manure.

He states his land to consist of a strong clay, and on the hills partly of a loose slate, which is easily pulverized when exposed to the atmosphere; he carries sand-marl on the strong clay, and fine light-blue clay-marl on the slatey parts: he generally sows clover on winter rye and winter wheat early in the spring in a rainy day, when the frost is off the grounds, and likewise with barley, after having used scarificators and horse-hoes; he prefers the red Dutch clover mixed with white, in the proportion of four to one when used on the low grounds, and of three to two when sown on the hill; the clover is never cut or grazed the first year, but is cut twice in the second year, at Midsummer and the end of August, or beginning of September; it is never made entirely dry when intended for hay, but is mixed with rye-straw in alternate layers, and some salt is thrown upon it, by which means the straw gets a strong flavour of the clover, and when cut into chaff, makes excellent fodder for cattle in the winter; the quantity of clover sown is 12lbs. upon an acre on the low grounds, and 14lbs. on the high grounds; neither horses, cows, nor sheep are depastured on the grass-fields, but confined to different inclosures.

Two different routines of cropping are adopted by Mr. Collet; one part of his land is divided into nine divisions, the other part into four. The course of nine crops is—1. barley,—2. oats,—3. potatoes, peas, beans, &c. the preparation for which is manuring with two-year-old dung or compost,—4. winter-rye on the high grounds,—5. winter-wheat on the low grounds,—6, 7, 8, and 9, clover. The four divisions are thus cultivated:—1. The ground dunged with compost for beans, peas, root of scarcity, carrots, turnips, and cabbage:—2. Barley, and clover sown with the drills:—3. Clover for summer stall-feeding cut twice:—4. Winter-wheat; and this mode of culture he would prefer on all his ground, if the frosts did not continue so late in the spring.

In conducting his summer stall-feeding, he cuts some grass on the terraces and about the pleasure-grounds, about a fortnight before the regular feeding begins, which is mixed with old hay and straw, and cut into chaff. The grass is increased daily, and in the last four or five days of this period, some new clover is mixed with it. This precaution is held necessary to prevent the cows from being subject to diseases, in consequence of the sudden change from old hay and straw to new clover only. In like manner, about

fourteen days before the winter feeding begins, the clover is diminished by degrees, and the new clover is cut into chaff with hay and straw, which makes the alteration gradual. During the time of stall-feeding, a basket of clover weighing 16lbs. is given five times a day to each cow, and half as much more to the bull; the clover is cut for each feed half an hour before it is used, and conveyed to the cow stable in a large basket on wheels: the mangers are cleaned every time before the clover is laid in, and the cattle are let out to watering in the morning and evening an hour each time, when the mangers are cleaned, the dung removed, and fresh straw laid under and behind each cow; two maids and two men are employed to tend 30 cows, a bull, and four calves; and their labour is minutely regulated by a table hung up in the cow-stable.

The summer stall-feeding commences with June, and terminates in September or October; and fifteen acres of good clover are found sufficient for 30 cows, a bull, four calves, and five horses, during that time. Without any pretensions to extreme accuracy, the quantity of butter made during the five months, is given at 7500lbs., and the cheese at 8000 lbs., besides 2000lbs. of an inferior quality, from the thirty cows before mentioned; and the manure procured by stall-feeding in summer, is asserted to be twice as much as could be obtained in the same time in the winter, and four times more valuable than compost.

Observations.—Though the farm where this management has been adopted is situated in a remote country of the northern latitudes, yet much useful instruction may be gleaned from it, and applied in our own country. The cutting the clover in such quantities as are used at one feeding, is an excellent mode of conducting soiling, which is not peculiar to any climate, and the gradual method of changing the food from dry to green, and *vice versâ*, is a valuable hint to be treasured up in the memory, and is of very extensive application. The mode of letting out the cattle for an hour in the morning and evening to obtain water, appears to be preferable to permitting them to remain in the paddocks all night, as practised by Mr. Curwen, except, perhaps, in the extreme heat of summer, when it may be in England occasionally necessary.

A Statement of the Mode of cultivating Flax and Hemp, in Russia, Prussia, and Poland. By JAMES DURNO, *Esq. British Consul at Memel.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

As this writer himself was not possessed of any great degree of knowledge respecting the subject of the communication, in order that the foundation on which the credit of the paper rests, may be fully known, he premises that, for the purpose of obtaining the best information possible, he transmitted a number of queries to such country gentlemen as had distinguished themselves most by their attention to the improvement of their estates, and might, therefore, be supposed to have combined practice with theory, and to speak from experience, as the result of both. On a general comparison of the several answers received, the result was,

SOIL.—That a black (not morassy), open, gravelly soil, had been found to produce the best crops both of flax and hemp; and as quality is more regarded in the culture of this crop than quantity, the growth was found too exuberant in land over-rich, so that care was taken to reduce this, as well as to raise an inferior soil to that state of cultivation in which these articles thrive best.

STATE OF CULTIVATION.—That the raising of previous crops was resorted to as the best means of ascertaining the state of the soil, and that the usual rotation was:—1. winter-wheat;—2. winter-rye;—3. barley;—4. oats, and then either flax, hemp, or peas; and a second crop of hemp if manured after the first; but in soils of less strength, the flax and hemp crops were taken immediately after the rye, the land being once ploughed and manured in the spring, and ploughed a second time for sowing; a naked fallow, however, only ploughed up, without being manured, had been generally found to produce the best of all flax crops.

SEASONS OF SOWING AND REAPING.—That flax and hemp were generally sown between the middle of May, and the tenth of June, and reaped, the flax at the end of August, and the hemp at the end of September; the sowing being postponed as long as possible, on account of night-frosts, which are thought very prejudicial; and it is observed, that though these countries are in the same latitude as Great Britain, yet the transitions from winter to summer are more instantaneous, and the heat and cold more intense; but the want of the advantages of climate enjoyed in England, is made up by the very great degree of nourishment which their soil receives from the flat, slimy, nitrous substance, which, on the melting of the snow, remains on the surface, and impregnates the ground to the depth of three or four inches, and

by the succeeding superior warmth and serenity of the weather, to which, doubtless, the equality of crops in those countries is to be ascribed.

Weeding.—That flax is weeded a short time before it blossoms, but that hemp requires no weeding at all, operating so far as a weeder itself, that by a crop or two of hemp, a very foul piece of ground may be cleared, and killing or suffocating all sorts of weeds, by the quickness of its growth, and the exclusion of the circulation of air.

Modes of Reaping.—That the *flax* is drawn or plucked, in the usual cultivation, when the stalks turn yellow, the pods brown, and the seeds become hard and full-bodied, for it is then perfectly ripe, and those seeds only will be fit for sowing; but those who refine on gaining flax of the finest possible quality, draw it earlier, while the stalks are yet green, and the seed grains quite flat; so that the seed is useless, though the flax is excellent: but that *hemp* is never drawn until ripe, which is ascertained, as in flax, by the stalks and pods changing colour, and the seeds becoming hard; but those who refine most on gaining hemp of the best possible quality, make a distinction between the male and female, drawing the former as soon as the stalks begin to change colour, and taking care to keep them separate.

Mode of gaining the Seed.—That the seed of the *flax*, when it has been drawn in a very dry state, may be stripped off immediately, or at most after lying two or three days in the field, after which, it is spread on a barn floor, where there is a free circulation of air, till it becomes dry; but for gaining the seed of the *hemp*, the stalks are carefully set up against walls, till perfectly dry, when the tops, as far as the seed-pods extend, are cut off to be threshed out; and it has been found that the seed of either flax or hemp, if instead of being immediately cleaned, it be suffered to remain any length of time in a moist state, the colour will be spoiled, and the seed itself so much injured as to become unfit for sowing.

Steeping.—That as soon as the seeds are separated, both the flax and hemp are immediately put into the steep, and carefully sunk below the surface, where they remain for nine or ten days in warm weather, but fourteen or fifteen days if the weather be cold; stagnant is preferred to running water, and large to small pools, because they give a whiter colour, though fish-ponds must be avoided, because the fish would be destroyed, and watering-places for cattle would be rendered unwholesome.

Drying after being steeped.—That after the *flax* is taken out and the water has run off, it is spread on a grass field so as not to touch the earth, and when it has lain for a fortnight on one side, it is turned on the other for another fortnight, when it is bound into bundles, and placed on one end till perfectly dry: but the hemp, instead of being spread out in a field, is set up again

on its root ends against the walls, and there spread out and turned towards the sun until dry, when this, as well as flax, is stacked into barns, so as to be exposed to wind without being exposed to moisture.

Dressing.—That the mode of breaking, cleaning, and dressing, as well as the instruments employed for the purpose, are the same as in other countries, but when the flax and hemp do not separate easily from the stalk, recourse is had to further drying in a room heated by an oven or stove, and every cultivator of flax fits up a small detached room for this purpose.

Having finished his account of the cultivation, Mr. Durno proceeds to observe that though much may depend on judicious management, yet it is an established fact, that the great difference in the qualities of flax and hemp is not to be ascribed to any variety in the mode of cultivating the land, or in the quality of the seed that may be used, nor, indeed, to any other circumstances than the difference of soil and climate; for experience has shewn that different districts under the same latitude, produce different qualities of hemp and flax. He has not discovered that the cultivation, either of flax or hemp, has been an object of encouragement with the government of any of the countries in question, but he believes it to be generally understood, that flax and hemp render more productive crops than any kind of grain, and this, indeed, appears from a calculation of their relative profits, which is given in the original paper.

Observations.—It does not appear from these accounts sent over by our late Consul at Memel, that the cultivation of flax and hemp is in a much more advanced state in Russia, Prussia, or Poland, than it is in our own country. Indeed, its culture seems there, also, to be limited, in a great measure, to the peasantry and the poorer class of farmers, whose situation renders them unfit to attempt improvements which must result from observation and reasoning. It is, however, worthy of notice, that the accounts here given, agree with the assertions of Mr. Somerville, of East Lothian, that the best crops of flax and hemp are produced on newly broken-up ground without any manure; and, indeed, did not experiments on a narrow scale at home, confirm the fact, it might be easily collected from the communication, that much of the waste land in England, and more in Ireland, is peculiarly calculated for the culture of hemp, which might be had recourse to with much advantage in reclaiming many of our wastes, since but little experience is necessary for managing the crop.

On the Culture of Potatoes. By the Honourable Baron HEPBURN. —*Communications to the Board of Agriculture, Vol. VI. Pt. I.*

IT is said that the culture of potatoes is of modern introduction into the eastern coast of Scotland; the father of the Baron assured him that the first time he had ever seen potatoes there, was in the year 1740, which was a year of severe scarcity, and these were imported from Ireland to Leith. The writer, however, believes they were known in Argyleshire a few years earlier. The culture of this root was, for many years after 1740, confined to the gardens, and they were first planted in the field in 1753 or 1754, at Aberlady, in Haddingtonshire, by a schoolmaster, of the name of Hay, and many people came far and near to see this natural phenomenon, and to learn the culture of the plant. At this period, it is said that the disease called the *curl* was unknown; and the species of potatoe principally cultivated in the field, and by the plough, was of a pale muddy-coloured red, and nearly round, and well-sized. This kind was considered as lost, but the Honourable Baron met with it, accidentally, about two years since, in the possession of a villager residing at the bottom of the Lammer mountains, who asserted that himself and ancestors had never changed their seed, and had cultivated it from time immemorial. Another species of potatoe was also formerly preserved for garden culture, not so productive indeed as the red, but supposed to be more delicate in flavour; a small white and flat kidney, which is also thought to be now irrecoverably lost. Neither of these species are believed to have shewn much flower, and still fewer apples, and these apples were generally gathered while unripe, and being pickled like cucumbers, gave a pleasant acid flavour, resembling the taste of the tendrils of the vine, or the green stalk of rhubarb. The species which succeeded to these, came from America, as the black Virginia, or from London, as the London-droppers; but the potatoe called, in England, the Scotch kidney, came originally from the West Indies; and none of these, for several years after their introduction, shewed much flower, or matured any apples. It is represented as deserving inquiry, whether this general absence of flower and matured apples, was occasioned by these several new species of potatoe not being sufficiently naturalized to the soil and climate, and some facts are promised which may assist the investigation.

The disease called the curl, is said to have been unknown in Scotland before the years 1778 or 1779, when the potatoes shewed much flower and matured their apples more frequently; but the curl was first heard of as a serious and an alarming calamity in the

autumn of 1780. The writer being at that time on a visit in Dumfries-shire, he was told that this disease had so infected the crop of potatoes in Cumberland, as to threaten the total exclusion of the potatoe from the husbandry of that county: he also remarked the appearance of it in many fields in Scotland, and the result of a more attentive examination was, the discovery of the disease in more crops than he had suspected; and he found many more apples, and some very large ones, highly matured, and the haulm, or stems, completely down, with the matured apples hanging upon them. It immediately occurred to him that the economy of Nature was thus instructing man to reserve all the potatoes, or fruit produced under ground, for his own food; and that he should exercise his industry in renewing his seed from the matured apple. He accordingly gathered a few apples, and having separated the seeds by rubbing them between his hands with dry sand, sowed them on a border in the garden, and transplanted the young plants where they rose too thick. Many potatoes of the size of pigeon's eggs were produced from the transplanted roots, and a still greater number of various lesser sizes; of these, the largest were selected, and planted in the garden the next season, which produced abundance of tolerably well-sized potatoes. The third year the planting was renewed, and the return was most abundant, nearly double the weight, ground for ground, to the produce of those planted any other way; in the fourth year the crop was still more abundant, beyond the crops of all his neighbours, and he had a great demand for seed.

The curl is stated to have made a general and an alarming appearance in the Lowlands of Scotland, in 1783 and 1784; but the plants which had been raised from the seed of the apple, were perfectly healthy and sound. From the observations he made in 1781, and the subsequent years, he was led to suspect that the potatoes produced by those plants that yielded the largest and best matured apples, would prove more liable to the curl, if used for seed in the following year, conjecturing that the matured apple robbed the fruit under ground, not of its nutritious, but of its vegetative power; for the potatoes from these plants were remarkably mealy and dry: and a few experiments satisfied him that his suspicions were well-founded. His own apple-seed continued pure and sound for some years after this; but his crops, although good, gradually abated, and approached nearer to the average of the adjoining crops. He, however, continued renewing his seed for two more years, but finding them carelessly mixed by the servants when he sent them to the field, he discontinued the practice; and as his neighbours had discovered a complete remedy in a change of seed from the higher country, and could trust that seed with safety for two years, he fell into their practice, and abandoned his attempts to raise plants from the apple.

He, however, pursued the inquiry through different parts of

Scotland, and found the curl avoided by change of seed, and that this new seed did not ripen the apples so maturely as the old. He has also raised excellent potatoes from the green substances formed at the knots of the stems, when broken by the wind, and thinks that the potatoes intended for seed should be sown very late, or else taken up early, to prevent the maturity of the apple.

The paper concludes with a suggestion to the Board, to take into their consideration the propriety of importing potatoes from various soils and climates, some better, and some inferior to our own, and distributing these importations in small quantities to growers of attentive observation; for he is afraid that premiums for renovating the seed from the apple would lead to endless frauds and impositions upon the Honourable Board.

Observations.—The general prevalence of the curl in potatoe crops, certainly renders necessary some attempts at prevention; and no experiments appear more easy and more deserving of encouragement, than trials of avoiding the disease, by sowing late, and by digging up the seed before the apple ripens, as these will ascertain whether or not the ripe apple deprives the fruit of the perfect vegetative principle.

Account of Swedish Turnips, produced in a Field at Tost, in Cheshire, in 1806. *Transmitted by Lord* SHEFFIELD.—*Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THE crop, which is the subject of this paper, was grown at Knutsford, in Cheshire; the produce was 785 lbs. per rod of 64 yards, which is 52 tons 6 cwt. to a Cheshire acre (nearly double the statute acre). Estimating the turnips at 4*s.* per load, and the tops at 2*s.* per load, the value of a Cheshire acre was upwards of one hundred pounds. The soil of the field was a light loam, inclined to sand, and this crop of turnips was taken after two white crops. After the second crop was got off, the land was fallowed as thin as possible, and harrowed as often as weeds made their appearance, and in this state it lay all winter. In the spring, about a month before the transplanting, it was ploughed again about eight inches deep, harrowed, and then drawn into ridges 27 inches asunder, and manured with strong compost, which was covered by throwing two furrows upon it; the top of the furrows was then raked off, and the plants set upon it. The seed had been sown at the end of March, or beginning of April, and was transplanted the first and second week in June, into the rows of 27 inches asunder, at a distance of 17 inches from plant to plant in the row.

It is mentioned as a common practice in Cheshire to plant Swedish turnips upon land on which had been oats the preceding year; the seed is sown in the middle, or latter end, of April, when possible, in some corner of the same field where they are to be transplanted; and if the weather has been favourable for them, they are ready to transplant early in June, but sometimes they are so late as the middle of July, and have even then turned to good account. The land is drawn into ridges, usually two feet asunder, though 27 inches is held preferable, and manured with a compost, and then the plants are put in at 17 or 18 inches distance in the rows. When weeds arise between the rows, the soil is ploughed from the plants, and when the plants are beyond all danger of being buried, the earth is ploughed towards them again, and these ploughings are repeated as long as they can be without injuring the crop. It is usual to get up a considerable quantity before the frost sets in, in order to have a constant supply, laying them out of doors in a long heap two yards broad at the bottom, and bringing them to a point at the top, so that the depth be about a yard, and then covering the whole with thatch, in which way they will keep good till late in the spring, but the bulk of them remains in the ground till they are wanted, and they have been quite sound till the end of April.

Observations.—This mode of cultivating Swedish turnips, which obtains only locally, deserves to be more generally followed, for, by transplanting the turnips into regular rows from the seed-bed, the plants attain to a much larger size than when growing promiscuously, since each obtains its proper portion of nourishment, and the land is kept clean with more ease, and at less expense. The pulling them and storing them for spring use, would be altogether unnecessary, if the rows were to be covered over with the soil by a double-mould-board plough, in the mode recommended by Mr. Munnings, of Norfolk, which would preserve them from the frost as effectually as stacking them in heaps and thatching them, and would be a considerable saving of expense.

An Account of the Expense and Produce of four Acres. By A. H. Chambers, *Esq. of Stratford Place.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

Mr. Chambers, conceiving it to be the duty of every individual, who makes a successful experiment, to give it publicity, communicates to the Board the expense and produce of four acres and thirty perches of very inferior land, selected for the purpose, situated on the summit of a hill in Enfield Chace; this admeasurement is stated to include the headlands, and the space on which a

wide-spreading beech stands in the middle of the field, so that the part under crop did not exceed four acres.

The land not having been broken up since the inclosure, he fallowed it in the first instance to destroy the turf, as a preparation for rye, to be followed by potatoes; and he wishes it to be received as a principle, that rye and potatoes, or tares and turnips, ought universally to explode the fallow-system within such a distance of great towns as manure can be procured; and he adduces two or three facts, which, he says, may be relied on: first, that it is not necessary to change the sets for potatoes; secondly, that small potatoes (frequently called *chats* in the vicinity of the metropolis) answer equally well, if not better than the large when cut; and, lastly, that trench-ploughing to the depth of twelve inches or more, cures the curl: all these, he asserts, have been proved by his experiments (if the culture of only four acres may be so called); and with respect to the curl in particular, he perceived it to prevail the first year he planted potatoes, where the land had received a shallow ploughing with a two-horse plough, but he never observed one plant curl upon fifteen acres for the three following years, though the sets were from the same land, with only the difference of deep ploughing. By an account of the money expended, and of the produce, it appears that a considerable profit would have been obtained had the land been in previous culture, but including the fallow preparation, the claying, draining, &c. the rye and potatoes repaid all the expenses within about twelve pounds, estimating the potatoes at only fifteen-pence per bushel, and the field was left in excellent order for a crop of wheat: the wheat, however, when sown, failed in a great measure, owing to the ravages of moles and wire-worms; but though the crop was extremely thin upon the ground from the destruction occasioned by these insects, and though a top dressing of lime and road-dirt was added in consequence, which would have otherwise been unnecessary, the crop made good the deficiency of the two preceding years, and afforded besides, a profit of 11*l.* 15*s.*; and the land was left equal to any on the farm: being restored to grass in 1806, it supported five South-down couples to an acre, for ten weeks, and was mown afterwards, and carried by the 20th of June, the crop being estimated at a load and a half per acre.

Observations.—The very limited scale on which this improvement was conducted, allowed Mr. Chambers to incur an expense which can never be extended to the cultivation of extensive wastes. The expenses of the two first years amounted to forty pounds per acre, and in the succeeding year to ten pounds an acre; and such an expense could scarcely fail to produce an adequate return. The spirit of improvement he has evinced, is well worthy the imitation of the opulent, and will obtain the approbation of those who cannot afford to imitate.

On waste Lands. By the Reverend JAMES WILLIS, *of Sopley, near Ringwood, Hants.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THE extensive parish of Christ-church was inclosed in 1803-4, and many of the proprietors evinced much commendable emulation in improving the heath-land, which abounds in that parish: one pursued one scheme with success, others failed in their object in the different degrees, as they preferred one mode of management to another; and this variety of management evinced which was the most profitable mode of reclaiming such wastes. Some of the modes pursued are detailed in this communication.

A Mr. Clapcott inclosed with an earth bank 3 feet high, $5\frac{1}{2}$ feet wide at the bottom, and 4 feet at the top, part of which was planted with furze, and part with quicksets. This experiment was first limited to a field of six acres, the success of which was to regulate his conduct, and determine the fate of the extent of his future inclosures. This is commended as a very prudent method of commencing heath inclosure, because proprietors, by thus feeling their way, before they advance too far, can retract or pursue their undertaking according to the success of it: to want of proper consideration, most of the failures in heath farming are attributed. A particular and accurate account is given of the different modes adopted in bringing into cultivation every one of the six acres, for a different method was pursued with each, but the items of expense and produce will not admit of compression. The first crop was turnips; and the acre manured with farm-yard dung and meadow loam, and that manured with farm-yard dung and malm, produced the fullest crop of turnips at the least expense; but the writer is inclined to think that the acre manured with farm-yard dung and chalk will be the most lasting and productive, and, though the dearest at the first, will be found the cheapest in the end; marl is represented to be the grand desideratum for such new broken up soils, but could not be obtained without too great an expense. At the inclosure, the land was valued by the Commissioners at half-a-crown an acre, and is believed to be now worth, at least, fifteen shillings.

A table is given of a series of experiments by another proprietor whose name is withheld, where manuring with dung, and paring and burning, were alone resorted to for improvement of similar heath land. The balance at the end of two years is against the cultivator, but the prospect of future crops is said to be promising.

The rest of the communication contains opinions rather than experiments, but many useful hints may be collected from the perusal of the original article.

Observations.—The details contained in this article can be only of local utility, as they are confined to the improvement of that kind of heath land, which is seldom found except in Hampshire, and the north of England. And though most of the recommendations relative to bringing such land into culture do not stand on the test of experience, yet they are evidently the emanations of a mind replete with observation, and stored with intelligence. Mr. Willis's more immediate neighbours will be prudent to observe his direction of beginning improvements on a limited scale, and extending them in proportion as they are successful.

On Irrigation. By EDWARD WILKINSON, *Esq. of Potterton Lodge, near Wetherby, Yorkshire.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THIS gentleman having witnessed the advantages derived from irrigation in Berkshire and in Wiltshire, was desirous of introducing the practice into that part of the county of York in which he resided, for the practice was scarcely known in the West Riding of Yorkshire. And knowing how much depended on the proper performance of the work, in order to overcome the prejudice naturally entertained against novel undertakings, he applied to Mr. Wright, the author of the Treatise on Water-meadows, who sent him a practical workman out of Gloucestershire; and though he obtained from this workman but feeble hopes of success, he determined to commence the undertaking, and succeeded so well, as to convert a common, which produced only from one half to three quarters of a ton of hay upon an acre, into a water-meadow, yielding two tons upon an acre, and of much superior quality, besides obtaining pasturage equal in value to the whole produce in the former state. The quantity of land is stated at 13 acres; the expenses of draining were 164*l.*; the former annual produce 22*l.* 15*s.*; and the produce after draining 65*l.* 16*s.*; and from the present appearance of the meadow, an increase of produce is confidently expected next year.

Observations.—These observations on irrigation convey rather the ardour of an enlightened mind in adopting the practice, than any information which was not known before. The example of Mr. Wilkinson will, doubtless, do much good in Yorkshire, where the practice is almost unknown; and his plan of obtaining an experienced workman to manage his undertaking, rather than going to work merely on the directions of books, is a mode of conduct well worth the imitation of gentlemen who contemplate agricultural improvements; for if this plan were to be uniformly pursued, many disappointments would be avoided, and many

undertakings which are abandoned at the first appearance of failure from their being improperly conducted, would be brought to a successful conclusion. We do not know any book better calculated to give right ideas on the subject of irrigation than the Treatise of Mr. Wright, whose liberality is well known to us, though we are personally unacquainted with him, and we avail ourselves of this opportunity of noticing (in case any of our readers should wish to apply to him) that he resides on his Rectory at Wold, near the town, and in the county of Northampton.

On Marl, Chalk, and Clay. By the Reverend James Willis, *of Sopley, near Ringwood, Hants.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

The farm, which is the subject of this report, consists of two hundred acres, in the parish of Christ-church, Hants, and has been occupied by Mr. Thomas Whicher, ever since the year 1776. This gentleman was early acquainted with the powerful effects of marl and chalk, as a manure for exhausted lands, and has had recourse to them for more than thirty years. This farm borders on the New Forest, where there is a valuable marl-pit, affording three different sorts, which have been all analyzed, and found to be of the purest kind. The yellow marl is found nearest the surface, the blue in the middle, and the shelly at the bottom; and though the latter might have naturally been supposed to have been the best, yet Mr. Whicher, who has tried all the three, asserts that he has never found any difference in his crops, and that the only variation he can discern is, that the shelly kind works more freely with the soil, and consequently mixes with it sooner than the others. The marl is removed in waggons immediately from the pit to the field that is to receive it, and the land is prepared by a winter fallow. This preparation is considered as the foundation of all future success, and is regularly attended to; and in the spring months the land is ploughed and dressed three or four times, and when brought to its cleanest and finest state in June or July, from twelve to fifteen waggon-loads per acre laid upon it, to be slaked with the sun and rain. If the season be not favourable, it is reduced into small pieces with mallets and hammers, which, though more expensive, is less beneficial than when the marl is pulverized by the atmosphere; and harrowings are afterwards employed till it be completely incorporated with the soil. Mr. Whicher manures after this with stable dung, and about the middle of August sows with turnips in the broad-cast way, and mostly obtains very abundant crops, which are fed off by sheep by the middle of October: the ground is then ploughed, and sown with wheat without further preparation, which gene-

rally succeeds well, but sometimes the seasons will not admit of a turnip-crop before the wheat. The usual manuring and cultivation are never omitted, as if the marl was solely relied on; and whoever relies on marl alone, it is asserted, will surely be disappointed. Marl is considered to remain with effect on the land for forty years, but chalk only for twenty at the most. Clayey loam and gravelly clay have been found most improveable by marl, and sandy loam by chalk. Marl is found to be very destructive to many kinds of weed, particularly to charlock and the corn-marygold; and though fallowing and repeated hoeing will do much towards the removal of these noxious weeds, yet, in the opinion of this writer, "if we rely on a pure and spirited system of husbandry for pleasure as well as for profit, we must have recourse to the marl and chalk pit."

The long experience which this intelligent farmer had had of the benefit of marl, induces him to proceed in his operations on the largest scale; the last experiment he made was on a field of sixteen acres, part of which was clayey loam, and part gravelly clay; this was taken in hand in the year 1804, the land being then eat up with weeds from the negligence of a former tenant. He first ploughed the field for a winter fallow, ploughed three times more in April, May, and June, and then dressed it with marl, fifteen waggon-load to the acre, which was speedily dissolved by the summer heat; in the beginning of August he carted on twelve loads of stable-dung to the acre, and the marl and manure were ploughed in together; one pound of turnip-seed was sown upon an acre, the crop was twice hoed, and the weight of it was twelve tons; this was eaten off early enough in September to sow red wheat, which yielded seven sacks per acre. The method pursued in this statement is strenuously recommended for restoring exhausted farms, on the principle that a readier and more effectual one cannot be pursued. For marl works with the soil most intimately even the first year, and assists the principles of vegetation more expeditiously than any other manure. The expense is given at ten shillings per waggon-load, where the marl-pit is very near the field intended to be manured, with a proportionate addition for carriage to a greater distance. The necessity of stable-dung in addition to marl, was fully proved by leaving a single acre in the middle of a field that had been marled and dunged, without any dung, and the produce was less by five bushels of wheat than that of the remainder of the field.

Mr. Whicher is stated to have never laid marl on grass-land but once, and that was in 1805, on a field of rye-grass and broad clover; it was fed early, so as to enable him to bring the marl on in the middle of June; the marl dissolved completely, and fifteen loads of cart-dung were added to each acre; the marl and dung were ploughed in, and the land sown with wheat in September, but the crop failed entirely, which was attributed to the

want of a winter fallow; and the failure in this instance is communicated to evince that the best and safest way is, attentively to pursue that mode of cultivation, which profit and practice have proved to be the most effective to the cultivator, and consequently to the nation at large.

In his occupation for thirty years, though Mr. Whicher has marled but once, yet he has chalked some parts of his farm twice, which time and experience convinced him was proper to be done. In 1804, he commenced the cultivation of a farm which had been much neglected by the preceding tenant; and though the surface was over-run with charlock and corn-marygold, the land was naturally good, and he did not despair of renovating this exhausted farm by the chalk system of improvement. He ploughed up a field of sixteen acres the first week in October, and fifteen loads of manure from the stable-yard were laid upon an acre, and wheat was sown the last day of October; the first frost after Christmas he carried on the young wheat four waggon-loads of chalk to an acre, but to prevent the wheat from receiving an injury from the pressure of the waggon, the chalk was put in a light cart, and spread with a shovel to cover the crop as even as possible; when the frost had decomposed the chalk, it was harrowed into the soil, and was completely washed in by the rains, and nothing but rolling and weeding were done after. The produce at harvest was seven sacks per acre, and the annual value of the land was improved from five to thirty shillings, and charlock and corn-marygold entirely disappeared.

It is observed that wheat as well as barley, after chalking, yields a grain perfectly bright and clear, and of a greater weight, and particularly fitted for seed-corn. The wheat crop, in this particular case, was succeeded by a crop of barley, which was remarkably stout, and produced five quarters to the acre; rye-grass and broad clover were harrowed in with the barley, which also yielded an abundant crop. There are two chalk-pits equally distant from this farm; the one hard and dry, the other unctuous and fat; both kinds were repeatedly tried, and the land which received that of the soapy quality produced the best crop by a bushel to an acre, which is attributed to the speedier dissolution of the soapy than of the hard chalk; but this difference is found only in the first year's crop. A waggon-load of chalk is valued at 30*s*.; and it is asserted that peas, vetches, and barley, on a loamy soil, are more productive with either kind of chalk than with marl, and that experience has shewn wheat, oats, and beans, on the heavy lands, to be most benefited by marl: the result of this experience has settled in the neighbourhood of Christ-church, which is the proper kind of land to be improved by marl, and which is best adapted to chalk. "Marl consolidates the texture, and sweetens the soil of sandy loams; chalk separates and divides clay, and renders it light for culture." And the forty years experience of

the gentleman mentioned, is adduced as indisputably confirming the fact that either of these manures may be used with the greatest advantage on any quality of land whatever. Chalk was also found to be an excellent dressing for grass-land, as it sweetened old pasturage, and thickened the sweard of new; and is considered a far better manure for pasture than marl has even been found.

Accident once induced this same agriculturist to employ clay as a manure: he removed an old clay-wall on part of a seven-acre field of rye-grass and broad clover, laying ten cart-loads upon an acre, and pulverizing it with great care, that the rain might wash it the more effectually into the land. In the spring these two acres had the superiority over the rest of the field, which was manured with turf-ashes; but in the course of the summer, their superiority disappeared, and the ashes beat the clay in the proportion of six to four. This experiment, however, is spoken of as inconclusive; and it is suggested that clay might be rendered more proper for dressings, if it were previously exposed to the atmosphere for a year, and turned over once or twice in the course of the time.

Another experiment of clay as a manure, by Mr. Wimpey, is also mentioned; he was impressed with a notion that clay was as good as marl or chalk; and in order to convince his neighbours of their folly, in using this manure, when clay might be obtained so much cheaper, he carried different kinds of clay on a ten-acre field, in the proportion of ten loads to an acre, treating it in the same manner as he would have done marl, both on arable and pasture; on the latter it was applied as a top-dressing, but was ploughed in on the arable: two acres were sown with wheat, two with barley, two with beans, two with oats, and the remaining two were continued in rye-grass; the soil was a black sandy loam on gravel. His neighbours waited with much anxiety for the harvest, to see the wonderful effects of clay; but the whole of his crops were miserable indeed, while theirs, which had been prepared for with marl and chalk, were as usual; and he found that his too sanguine expectations from clay as a manure, had only rendered him the dupe of expense and labour, and he abandoned the system for ever. Mr. Wimpey's clays, however, are represented as being of the very worst sort, and the writer conceives, that with respect to the operative qualities of marl and chalk, and even of clay, "the husbandman that reasons on their quality, and applies them accordingly, must ultimately reap as to himself uncommon advantages; and the nation, to which such a cultivator belongs, more grain and more cattle for its consumption."

Observations.—The account of experiments which is given in this communication is especially deserving the notice of agriculturists, as it furnishes a species of information not very commonly

obtained through the medium of books—the failure of attempts at improvement. The trials which have been made with clay as a manure, have uniformly failed of success, but few men have had candour enough to give publicity to their errors and mistakes; if this question was not set at rest before, it may surely be now dismissed from consideration; unless future experiments be made under entirely new circumstances. With respect to chalk, it has long been used as a manure, and with much success, in Bedfordshire and Hertfordshire, and much useful information on the mode of application may be found in the Agricultural Surveys of those counties. Its duration, perhaps, has not been so accurately considered, where it is a common and cheap manure, as in Hampshire, where it was obtained at more expense; but on the Bedford and Hertfordshire hills, it is renewed oftener than once in ten years, more frequently once in seven or eight years; the soil, however, being almost entirely covered with flints, may absorb it sooner than the heaths in the vicinity of Christ-church. The most valuable part of this communication is that which relates to marl, which places that substance in a new point of view—not as a manure of itself—but as a basis for other manures, for this is the view in which it is placed by Mr. Willis; he considers it of but little use to apply marl unless the land be manured with farmyard dung at the same time, and observes that the conjunction will produce such a crop in point of bulk as will furnish means of supply for manuring in future, and that the effects of the marl will be perceptibly felt in this way for twenty years. Now this is the true system of farming—to obtain crops sufficiently rank to afford plenty of manure for future crops; and we have little hesitation in observing, that the failure of an industrious farmer may be, in most instances, attributed to the want of one rank crop, which will lay a basis of manure for cropping for the future.

Experiments regarding the Improvement of the fine-woolled Breed of Sheep in this Kingdom; in a Letter to Sir John Sinclair, Bart. By Edward Sheppard, *Esq. of Uley, Gloucestershire.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

This gentleman, being anxious to ascertain to what degree of perfection wool might be brought in this country by means of the Spanish cross on fine-woolled English sheep; and wishing to be satisfied whether, under the common circumstances of the husbandry of the country, such wool would retain its fineness; and from being at the same time largely engaged in the manufacture of superfine cloth, and in the practice of buying and working up considerable quantities of Spanish wool yearly, conceiving himself entitled to form with some accuracy an estimate of the relative quality and

value of such wools as might be produced in this country in competition with the wools of Spain, he determined upon commencing a series of experiments; and with this view sent, in the year 1800, twenty Ryeland ewes to a Spanish ram of Lord Bathurst's, which had been obtained from the King's Merino flock. In the produce of the first cross he found a considerable improvement of the wool, which so much resembled Spanish, that it might be considered as approaching half-way; the weight of the fleece was also increased one-half; of this wool he preserved a large specimen. In the following year (1801), he obtained a ram and three ewes from the King's flock, and purchased from four to five hundred Ryeland ewes, selecting, with great caution, the finest woolled sheep from the best Herefordshire flocks: in 1803 and 1804, he also purchased a considerable number of a reputed Spanish flock in Herefordshire, from a Mr. Ridgeway, who had been many years in possession of part of His Majesty's sheep, on which he had engrafted his own Ryeland flock, but the produce was a mixed and unequal breed; he likewise availed himself of other opportunities of purchasing sheep of the same breed to such an extent, that, in 1805, he was enabled from the increase of his flock to dispose of all his Ryeland ewes; and at this year's shearing, the average weight of his fleeces washed on the sheep's backs was $2\frac{3}{4}$ lbs.

In 1806, his Spanish and mixed flocks amounted to 986, exclusive of lambs, and the average weight of his fleeces was 3 lbs. washed as above; the value of the mixed wool being 4*s*. 6*d*. and of the Spanish 6*s*. 4*d*. per lb. while the price of Spanish wool imported was at 6*s*. 9*d*.

He found it expedient to wash the wool on the sheep's backs in the common mode of this country, because the dirtier part of the fleece near the surface, was considerably cleansed thereby, though the wool is too closely compacted to admit of much impression in the grease at the root of the fibre, which, however, yields easily to the common process of the manufacturer; for, in proportion as the cross from the English approaches the Spanish breed, it acquires the same property of yolk. And it is stated, that the shearing is much facilitated by the wool being washed on the back of the animal; besides, the attempt to wash the wool after it has been shorn, as is the practice in Spain, would be attended with many difficulties to the grower, and be very disadvantageous to the manufacturer, as in the process of scowering the wool would be much injured by the soiling of the liquor used in the operation; he conceives also the wool washed from the sheep's backs is in the most merchantable state, since it is sufficiently free from excessive grease to enable the manufacturer to judge of its probable waste, which experience will soon teach; while the attempt to produce the wool scowered clean, would be much more objectionable; because, from the inexperience of the

party, it would most probably be injured in its softness and quality. His lambs he has not sheared, because he found them meet the winter better with their coats on, and the produce of wool was greater at the next shearing.

The first reflection which occurred to Mr. Sheppard, on the adoption of these sheep, was, whether it is likely to be advantageous to the community, and he is decidedly of opinion, that a judicious culture of fine wool must be productive of the greatest benefit to the agricultural, as well as to the commercial, interests of the country; since, in the variety of soil and situation which England affords, there are many districts where this breed of sheep might be cultivated with success, to the exclusion of the wretched and unprofitable flocks, which are now depastured there, for he thinks there is not a breed of clothing-woolled sheep in England, which would not produce a fleece from four or five repeated crosses with the Spanish, worth at least four shillings the pound, washed on the sheep's backs; and consequently it must be to the interest both of the farmer and the community, that poor and mountainous tracts of land should be applied to the growth of this sort of sheep; but a different opinion is acknowledged with respect to the rich and highly-cultivated parts of the kingdom.

The comparison of four years' successive produce from the same sheep, has satisfied him, that without extraordinary care to guard against the effects of climate, and a strict abstinence from the more nutritious and succulent kinds of food, the wool of the mixed breeds will materially degenerate. At the time of writing, he had before him samples of the wool of his first crosses from Lord Bathurst's ram in 1802, and the wool from the same sheep in 1806, and he found the quality so much degenerated in the course of that time, that he conceived the lapse of another equal period, would reduce it to the coarseness of the maternal stock; at the same time he observes, that this is the first cross from the Spanish, which he does not consider as possessing equal preventives with those of higher blood against the causes of degeneracy. He has also found the wool of His Majesty's ram much degenerated by a comparison of the wool of 1803 with that of 1806, which is attributed to his being kept in the best pastures in the summer, and fed with corn in the winter, and being worked very hard; but the same depreciation has not been found in the females, which have not been kept in such high condition. It is remarked that in the pure Spanish there is a wonderful capacity for resisting the effects of climate on the quality of the wool, for the great exudation from the body of the animal, yields a yolky consistence at the interior of the fleece, which by its mixture with the soil forms a kind of coat of mail on the surface almost impervious to wet, and protects the sheep exceedingly from the injuries of climate; and the same quality attends the mixed breed in the proportion of its approxi-

nation to the Spanish. The fact of deterioration, however, under the common circumstances of the husbandry of the country, is not deemed as affording cause in any serious degree, to affect the value of fine-woolled sheep, for the preventive is always at hand,—a frequent recurrence to the Spanish ram, which will, at all times, remedy the evil. It is thought to be very practicable to grow wool of the value of 5*s.* 6*d.* per pound, while Spanish wool reaches 6*s.* 9*d.*; by which means we should rival two-thirds of the import from Spain; but in order to keep up the means of perpetuating the fine-woolled mixed breed, and of supplying the growers with the pure blood, there should be a flock of the real Spanish race carefully preserved from mixture, and protected from degeneracy; and the writer considers the flock now in His Majesty's possession, as eminently fitted for the purpose, and is satisfied that a breed of sheep as pure as those are, with strict caution both to the nature of their food, and to their complete protection from the effects of climate, would remain for a century in the same state of fineness and perfection; the circumstance having been proved by experiment, for the mixed breed in Saxony, which was first introduced in 1714, has, with these precautions, retained the greatest possible degree of fineness up to the present time; and the best wools from that country equal in smallness of fibre, and exceed in softness of feel, the finest wools of Spain, and are eagerly purchased at higher prices by the manufacturers of this country; and as the mixed breed of English and Spanish partakes very much of the soft and silky feel of the Saxon wool, he has no doubt but that it might be brought to the same degree of fineness, if the same attention be given to its culture; he is, however, disposed to attribute much of the softness perceptible in Saxon and Anglo-Spanish wools, to the management in washing on the sheep's backs, and suffering the wool to remain a long time in its native grease; whereas, in Spain, the wool being washed with both hot and cold water after being shorn, the grease is, in a great degree, discharged, and it is besides compressed so closely in the packages, that when opened in this country, it is so hard, as frequently to make it difficult to divide the flakes.

Mr. Sheppard observes, that though M. de Lasteyrie, and other modern writers on Spanish sheep, have asserted, that the quality of the wool does not depend upon the nature of the pasturage; he himself is of opinion, that they are neither borne out by facts, nor by sound reason; he admits, that as far as being essential to the health of the animal, nutritive pastures are necessary to the production of good and healthy wool, having frequently remarked that the wool of a half-starved sheep is void of proof in the manufacture; but is convinced that, when the animal is kept high, and pushes forward in its growth by nutritious food, the fibre enlarges with the other parts of the frame, and that an increased weight of wool so produced, is attended with a dete-

rioration in quality. As an instance of this, the wool of the Real-Paular flock is noticed, which was purchased a few years since by the Prince of the Peace at a very high price, on account of some privileges of pasturage exclusively belonging to it, such as a priority of feeding in the finest pastures in its way to the mountains; the sheep of this flock, from the advantages of pasturage, are represented by persons conversant with the flocks of Spain, to be large and handsome, but the wool of this pile is known to the manufacturers here, as broad and coarse in hair, in comparison with other fine Leonesa piles; and this deterioriation of the wool is attributed to an habitual indulgence in more luxurious food; for it was in the highest estimation in this country fifty years, and cloth then made from it was so marked to denote its superiority. Though it is allowed that Lasteyrie has communicated much pleasing and useful information, yet no great weight is attached to his observations on the subject of depreciation, since he asserts that the fineness of the wool is not at all owing to pasturage, soil, or climate, and that the richer and more succulent pastures increase the fineness of the wool, and that dry herbage contributes to its coarseness: the assertion that the wool of the Spanish flocks at Rambouillet, in France, is increased in length, without being depreciated in fineness, is received with much doubt by this writer, as contrary to all the experience he has had in wool.

In concluding this communication, Mr. Sheppard says, "I do not assert that it is impracticable to produce and to preserve in England wool equal to the finest quality in Spain, with the same management as is practised in countries under climates somewhat similar, but, that where land is so valuable, and where a regular course of husbandry is adopted on a comprehensive scale as with us, I do not think such management can be looked for; but in many districts of less fertile land in this kingdom, I am convinced, the farmers, from three or four successive crosses with the Spaniard, would obtain fleeces worth from 10*s.* to 15*s.* each, from almost any sort of short-woolled sheep;" and the Ryeland is recommended in preference to the South-down breed to those who can afford to choose their flock for this purpose, because the finest hair of the South-down bears no proportion in point of softness to that of the Ryeland. It is observed also, that the produce of a cross with the Spaniard are neither less healthy nor more subject to diseases than other sheep; but since they are tender as lambs, the ewes should yean as late as the month of March, and as the lambs fall very naked, they should be sheltered from bleak and exposed situations; they are said to keep themselves in good order upon bare pastures, and to stand going to fold as well as the South-down. This gentleman also found them fatten very handsomely; he sold half a score six-tooth wethers of the first cross, which averaged 19 lbs. per quarter, and he readily obtained

a penny per pound more than the market price, on account of the beauty of the meat, and its great fatness, and quotes the testimony both of amateurs and adversaries, to the mildness and excellency of the mutton.

Observations.—The gold medal of the Board of Agriculture was voted for this communication of Mr. Sheppard, who, as an agriculturist, and, at the same time, a manufacturer of experience, must be, in every respect, competent to judge of the expediency of introducing the Merino-Ryeland generally into this country. Full as is the Essay of Dr. Parry on this subject, additional information on important practical points may be collected from this communication. The information contained in it, which is now given to the public for the first time as the result of experiment, is the certainty of degeneracy in a mixed breed, removed only one cross from the Spanish; and when the means of information which this writer possesses are taken into the account, this opinion, that the wool will degenerate to its former maternal state in eight years after the use of the Spanish ram, may be very safely relied on. His suggestions respecting the improvement of Anglo-Spanish wool to such a degree of fineness as may be readily obtained without causing any change in the regular agricultural systems of the country, instead of aiming universally at extreme perfection, is evidence of a sound mind and enlightened understanding. As an extensive manufacturer of fine cloths, he knows how few pieces are made entirely of Spanish wool, without some admixture of British to facilitate the working; and it is easy to discover it to be his opinion, that native wool, rather inferior in fineness, may make as good an article of cloth, in consequence of the superior silkiness and softness obtained by washing the wool on the sheep's backs.

On the Mildew, and other Diseases which affect Wheat. By the Conductor.—Farmer's Magazine, No. 36.

The wheat crop of the last harvest being very much injured by diseases of various kinds, Sir John Sinclair circulated some queries on the subject, the answers to which form the subject of the present paper. The writer states, that though mildew acted as the destroying agent in many instances, yet he conceives that the defectiveness of the crop may, in some cases, be attributed to other causes, for that the general injury seems to have proceeded from the unhealthiness of the atmosphere at the time when the grain was in an imperfect state, from which cause something like abortion appeared to take place in the parent plant after the young grain was formed, which occasioned many cups of the ear to be void,

and destitute of substance, and even the grain which arrived at maturity, frequently turned out to be of perfect or imperfect quality according to the nature and condition of the soil upon which it was produced, One or other of these circumstances is stated to be applicable to one half of the wheat-crop of 1808; it being evident from the colour and texture of the straw that they were perfectly free from mildew, but suffered in consequence of excessive rains having fallen at a critical period of their growth, whereby barrenness in the ear necessarily followed; and this barrenness, though it occasioned the produce to be short, did not prevent the straw from being healthy; whereas had mildew been upon the straw the case would have been otherwise, for by that baneful disease the circulation of the plant is stopped in a degree proportional with the extent and severity of the malady. From these statements the writer infers, that mildew was occasioned upon certain soils by the influence of an unhealthy atmosphere operating upon the plants at a period when they had become weak and sickly; for owing to the uncommon heat which prevailed through the month of July and a considerable part of August, wheat plants upon all soils not composed of clay or strong loam, were in a manner at a stand with respect to growth, being parched and enfeebled by the fierce rays of the sun, while they were seldom cooled or refreshed by a genial current of air, and the ground, in consequence of this intense sunshine, felt something like a new-burnt brick when taken from the kiln, so that when rain fell, putrid effluvia seemed to issue from the ground from every part of the surface, which endangered the wheat-crop already in a sickly state, and the corn became a victim to the pestilence which raged in the atmosphere.

The earliest symptoms of danger to the wheat are related to have been recognised about the end of July, when a multitude of insects took possession of the ear of the plants, which they seemed to devour with the greatest avidity; in this stage mildew was not discernible, though the seeds of the disease might have been sown, but it is believed that the warmness of the ground when the rains commenced, joined to the sultriness of the weather at the time, occasioned in some measure a kind of putridity in all plants, and that insects were thereby brought into action, something in the same way as takes place upon every kind of decayed substance, whether animal or vegetable, and mildew was not afterwards found to be most prevalent in fields where insects had been discovered; that fatal distemper prevailed mostly upon light, soft soils, debilitated by previous drought; and the longer it stood upon the ground, both corn and straw became worse, instead of making any improvement; and it is inferred from this circumstance, that mildewed wheat ought to be cut as soon as possible after the disease is discovered. The weather was very wet at the commencement of the mildew, and though it after-

wards became dry, yet the progress of the disease was not arrested.

The writer is not aware that any measures were taken to prevent the progress of this disease, nor does he think that any thing can be done to retard or impede the progress of this baneful disorder after it has once appeared; the only preventives which have suggested themselves to him are thin sowing, and the use of the smooth-chaffed wheats, as these are all less obnoxious to, and less injured by mildew than bearded wheats: the real mildew was found mostly upon loams, poor gravels, and thin clays, though other soils did not preserve the crops free from disease, as the general barrenness prevailed on all sorts of soil: no difference was noticed between wheat sown in the autumn and that sown in the spring, nor whether the fields were open or inclosed; but in all cases and under all circumstances, the flour was found to be of inferior quality.

Some notice is then taken of the smut, which is described to be a disorder different from blight or mildew, and is attributed to a defect in the parental seed, whereas other diseases proceed from causes in the atmosphere; but it matters little, in the opinion of this writer, what weather happens afterwards, if the seed be sufficiently pickled before it be sown, nor whether it be lodged or not, as neither of these circumstances occasions smut. And though a certain class of agriculturists consider pickling wheat for seed as mere quackery, yet it is asserted that the real practical farmer will not act in this way, but will conclude that a practice sanctioned by long experience ought not to be hastily renounced; and he will not lightly deny the utility of pickling, only because he cannot comprehend how the effect is produced, since it is known for a certainty that the steeping or sprinkling of seed-wheat with certain ingredients effectually prevents the crop from being smutted.

Though mildew was mostly prevalent in the wheat-crops, yet some instances are adduced where the same disease obtained among oats; the barleys also are said to have sustained damage in some instances, though the bulk of this grain was out of danger before the rains fell; a want of sunshine and heat is, however, considered alike detrimental to wheat and barley, though last year the causes of disease did not arise till the barley was beyond their reach.

Observations.—Many of the remarks in this paper are extremely judicious, and worthy the attention of agriculturists, who contemplate experiments on the diseases of grain; and though much new information is not to be collected from it, yet many valuable hints are afforded.

On Smut and other Diseases in Wheat. By a LANARKSHIRE FARMER.—*Farmer's Magazine, No. 36.*

THOUGH the blight and mildew are slightly noticed in this paper, yet the principal part of it is devoted to the smut; and it is remarked that though many able pens have been employed, all, as yet, have failed in finding out the true cause of the disease. The remedy of pickling well with old stale chamber-ley, and drying again with hot lime, is mentioned as the most certain preventive that has been yet found out; and the writer coincides in an opinion, held by Sir John Sinclair, that old wheat used for seed is less liable to smut than new, and particularly if old thrashed; but at the same time confesses that neither certain information nor his own experience have induced him to rely upon the use of old wheat as so sure a preventive against the smut as pickling; and he apprehends that there is a greater risk in pickling old wheat than new, because old wheat being entirely deprived of its unripe moisture, and other dampness which new wheat is liable to, imbibes too much of the pickle, and thereby kills the gum in both the diseased and the healthy grains, which is not the case with new, for the healthy will not imbibe so much as to hurt the gum, while a small portion of the pickle destroys the disease altogether. With respect to his own practice, he could never resolve on sowing wheat without pickling; and he asserts, from thirty years experience, that he has never suffered one shilling from smut, though a partial ear has sometimes been found in a field after common picklings, but whenever he was at the pains of washing clean, and swimming off all the light and diseased grains previous to pickling, such a thing as a smutted ear could not be found on the minutest examination: he performs this operation by putting the wheat into a large tub, and covers it well with water, stirring it with a broom to clean the corn and bring the light to the top, which is carefully skimmed off, and the water changed till it ceases to be discoloured; the wheat is then pickled in the common way, and dried with hot lime. And this preparation is held to be effectual, whether the disease proceeds from an insect produced in the grain possessing animal life while the blade is growing, and the ear forming; or from some unsoundness in the grain itself; for the pickle kills the unsound grain, and at the same time destroys the animal life of the insect. The writer states, he has long been of opinion that if perfect, good, healthy, and sound seed, were constantly sown, whether old or new, the smut would seldom make its appearance, for extensive practice has convinced him that the disease proceeds from the grain, and is not caused by the influence of the atmosphere.

Observations.—The philosophical and practical remarks on smut contained in this short article, must recommend it to every sensible husbandman, whose object of research is useful knowledge and not idle curiosity. The facts stand on the incontrovertible test of thirty years experience, and the inferences are obtained from the closest reasoning of philosophy.

On the Norfolk Horse-rake, and on Chains for Stable-doors. By W. N.—*Agricultural Magazine, No.* 15.

This horse-drag-rake, which is illustrated by a plate, is attached to the gallows or stand of a Norfolk plough, and the implement is recommended from the experience of the writer; the head is eight feet long, and two inches and a half thick, by three inches deep, supplied with tines placed about three inches asunder, and projecting out of the head nine inches. This head is fixed to a beam which rests upon the bolster of the stand, in the same manner as the plough-beam, and is kept steady by braces on both sides; and to prevent the teeth from getting too much hold of the earth, two truck-wheels are screwed through the head with screws of sufficient length, that, if it be requisite, chucks may be introduced between the bar and the head of the rake: the distance recommended is eight inches and a half from the head of the rake to the axis of the wheel.

It is not pretended that this rake will be found competent for all the operations to which horse-rakes are applied, but it is asserted that its utility will be very conspicuous in gathering the couch-grass and rubbish together in ridges, after it is harrowed out of the land, and in collecting the refuse on hay or corn stubbles, when the swarth is removed.

The chains for stable-doors are common chains fixed to one door-post, with a screw at the other extremity, which screws into a nut let into the other post by means of a winch, and cannot be unscrewed without it.

Observations.—The rake here described, is certainly useful for the purposes for which it is recommended, on flat and level lands, but is altogether inapplicable to those parts of the kingdom where the land is laid in ridges. The chain for stable-doors is ingenious, but too much of a nick-nack to be adopted in common use.

Elegant Economy in Cucumbers. By Mr. John Saunders, *of Stroud, Gloucestershire.—Agricultural Magazine, No.* 15.

It is remarked that when cucumbers are scarce and dear, one half of the cucumber is frequently put away by the housekeeper,

for the following day, and the consequence is, that it loses much of its freshness and bloom, and if kept for any length of time, becomes flaccid and insipid.—To remedy this inconvenience, Mr. Saunders advises to cut the cucumber across the middle with a sharp knife, while growing on the vine, in which the remaining half will be preserved in equal perfection, and will also continue to grow!

Observations.—This *elegant economy* reminds us of the dinner story told of the Abissynians by Bruce, who, as a humorous poet expresses it,

"Eat half an ox, and turn the rest to grass."

Account of a small Crop of Sun-flower Seed. By CULTIVATOR MIDDLESEXIENSIS.—*Agricultural Magazine, No.* 16.

THE sun-flower plants of this writer stood in detached and somewhat distant spots of ground, not amounting in the whole to half a rood; some were self-sown, which proved the earliest and best, part were sown in March, and part later; the soil was, of one patch a wet clay loam, of the others excellent mould. None of the stalks exceeded seven feet in height, and each stem contained generally four, five, or six heads, the largest flower always producing the greatest quantity of seed, which gradually decreased in the remainder. The gathering was from the 26th September to the 6th October, and very many heads were weighed, but there was not a single plant which produced more than five ounces of seed, of which the master-flower, or head, generally produced two ounces, and many plants with six flowers produced only two ounces and a quarter. This sun-flower seed too was weighed in its heavy husk, which was found by repeated experiments in money-scales, to be heavier than the seed itself, in ninety-nine cases out of an hundred. A comparison is then entered into of the acreable produce of this seed, with the respective kinds of corn, and it is shewn to be inferior even to buck-wheat.

Observations.—One of the *splendid* suggestions of Mr. Saunders of Stroud, has been completely put to the test by the writer of this article, and the result of the experiment has been precisely what we predicted, and may serve as a guide to appreciate the value of Mr. Saunders's agricultural projects.

On the comparative Advantage between the Use of Oxen and Horses, in Husbandry Work. By Mr. ROBERT DAWSON, *of Great Bentley, near Colchester.—Agricultural Magazine, No.* 17.

MR. Dawson, in 1804, purchased in Smithfield a pair of Sussex oxen, five years old, at 19*l.* each; they were in good condition, and

walked quickly; they ploughed an acre a day in the same field with two horses (without drivers to either of them). They were fed each of them, with two bushels of malt-coombs per week, which cost 1*s.* 3*d.* and two bushels of bran, which cost 1*s.* 9*d.* making a total of 3*s.* with some chaff and good oat straw as much as they were inclined to eat: the two horses were worth 30*l.* each, and were each fed with two bushels of oats and two cwt. of hay per week, of the value of 13*s.* with chaff and oat-straw the same as the oxen. The quantity of ploughing performed by each, was the same. The oxen improved in value, and were fattened on turnips, and were not liable to so many accidents as horses. He is convinced that if oxen be properly trained and fed, they will answer every purpose of husbandry; but unless the experiment be set about with prudence, ardour, and perseverance, it will often fail in countries where there is so much prejudice against the use of oxen.

Observations.—Mr. Dawson's experiment plainly shews, that oxen may be fed at less expense, and at ploughing a light soil (for that is the nature of the soil where he lives) will do as much as horses. This however does not bear him out in his inference that they would answer *every* purpose of husbandry; but if properly *managed,* as well as *trained* and *fed,* they might in most cases be advantageously used in light soils; but it does not follow that the same advantages would result from employing them on heavy soils and stiff clays, for which horses, notwithstanding the greater expense of maintenance, have always been considered better calculated.

On labouring Oxen. By D. B.—*Agricultural Magazine, No.* 17.

The writer states, from twenty years experience, that he has reaped considerable advantage from the use of labouring oxen; he has his oxen shod in a break, which he erected for the purpose, conceiving it to be a better mode than casting them on a dunghill; they work in harness, and the traces are so fixed to the collars, that the animal may draw from the shoulders and not the breast, which plan is held far preferable to yokes, as the head is not kept so near the ground, and every animal acts independently of the others. He purchases his oxen at three or four years old, and feeds them in summer with good grass, and at other times with malt-coombs, bran, chaff, and oat-straw, and after keeping them four or five years, they are fattened with turnips, or oil, and good oat-straw (hay being found unnecessary), and usually bring at Smithfield about three times their original cost. To induce his best ploughman to go with the oxen, he allowed him extra wages,

which plan is recommended as the best method of overcoming the prejudices usually entertained against the use of them. It is also mentioned as a consideration of great weight at this juncture to promote the use of oxen—that of preventing the consumption of the food of man by horses as much as possible.

Observations.—The great experience with which this writer speaks of the advantages of labouring oxen, entitle his observations to that attention which would not be otherwise due to an anonymous article.

On covering the Ground with green Crops, and on naked Fallows. By Mr. JOHN WRIGHT, *of Pickworth.—Agricultural Magazine, No.* 17.

THOUGH it is the received opinion of many agriculturists, that the more the ground is kept covered with green leguminous crops, the more it is improved; yet this writer states, that he is puzzled to know how it happens, if the sun is so injurious to the ground, that it does not injure naked fallows materially, since these have, or at least ought to have, nothing to intercept its rays. Daily experience however shews, that no injury arises in this case. Mr. Wright says, that he is himself an occupier of open field lands, which custom obliges him to fallow every third year, and so far from the sun having injured them, he has uniformly found that those who stirred their ground the most frequently, and exposed it the most to the sun, and kept it the cleanest from weeds, have always reaped the best crops and improved their land the most. He is of opinion, that heavy lands can scarcely be tilled too much during the summer, and has no doubt but that weighty crops of wheat may be obtained from them, merely by dint of ploughing without manure; but light lands, he conceives, may be ploughed too much, and are injured by it, since frequent ploughing adds to the lightness, and heavy rains wash away the finest part of the mould; and therefore, perhaps lands of this description might be more improved under a smothering leguminous crop than by a naked fallow; but he insists that heavy lands never return so heavy a crop of wheat after either clover or beans, as after a complete summer's fallow, and he hopes for an opportunity of trying the experiment "whether a piece of strong land of indifferent quality, where manure is scarce, might not be profitably cultivated under fallow and wheat alternately without any manure." The argument against it is admitted to be the circumstance of two years rent and labour lying upon every crop. When however this writer speaks of fallow, he does not mean those sort of fallows, where the weeds are suffered to grow to maintain a few miserable sheep, for there should neither be a sheep upon fallow, nor a weed to feed them on; the farmer should see all the enemies he had to contend with, and the

ploughings should follow each other at short intervals, half the fallows in England being spoiled by lying too long between the ploughings.

Observations.—The difference between heavy and light soils, which is judiciously made in these remarks, will at once convince the intelligent reader, that the same system is not applicable to both. The advocates for a succession of green crops are generally farmers on light land, who forget that a different soil requires a difference of management. The distinction of management marked out by Mr. Wright, is well worthy of attention.

Hints in regard to certain Articles, which might be substituted for Grain in the Manufacture of Drink. By an ABERDEENSHIRE CLOWN.—*Farmer's Magazine, No. 36.*

THIS paper is confined to the recommendation of some extraneous resources, which might probably be introduced for diminishing the usual consumption of grain in the manufacture of drinkable liquors, the writer conceiving, that however expedient it may be thought at the present time, and during a temporary scarcity of grain, to encourage the distillation of spirits from sugar, yet at some future period it may not be equally politic to rely on a colonial produce, and therefore points out a few native articles, which might become most extensively useful in the manufacture of drink.

The first substitute recommended is *the bloom of heath or heather,* from which a fine agreeable beverage is said to have been formerly prepared by the Picts, though the secret of preparing it is believed to have been lost, when that ancient race became extinct: it is inferred as a natural conclusion, that a vegetable which covers so many thousand miles, and that so closely, as almost to exclude every other vegetable, must possess qualities highly beneficial to the regions where it is so exuberant; having a fine aromatic flavour, and an agreeable and somewhat sweet taste; and the bees, who are deemed the best judges of vegetable sweets, and the best extractors of them, being found to prefer the bloom of heath to all other flowers, it seems to follow of course that there is a very strong sweet in the bloom of heath, which the writer thinks, if gathered at the proper season, might be converted into a wholesome and palatable liquor, either separately or with some mixture of liquor from grain.

The next substitute suggested is *whey,* of which the quantity is immense, though it is frequently cast to the dunghill, or not much more profitably consumed in an attempt to feed swine; this is believed to have been one of the most ancient beverages, and its wholesomeness is strongly insisted on. The ancient Highland intoxicating liquor, called *blandium,* is stated to have been made from whey and herbs fermented together.

The remaining substitute is *honey*, which, though yet in use, is thought to be daily declining from the undue avarice and culpable carelessness of bee-owners. The various kinds of liquor which might be manufactured from honey are fully described, and warmly commended; and the paper concludes with a recommendation to the Highland Society of Scotland, to promote the inquiry by offering premiums for successful experiments.

Observations.—Though the ideas in this paper are many of them fanciful, yet they by no means merit contempt. The recommendation to the Highland Society may perhaps be attended to from a countryman; but unless a beverage as palatable as whiskey could be prepared from the substitutes mentioned, it will probably be recommended in vain to the population of the northern mountains of Scotland.

On the Application and Effect of Gypsum as a Manure for the artificial Grasses, &c. in Reply to Queries proposed by Sir John Sinclair. By Mr. SMITHE, *of Tunstall, near Sittingbourne, Kent.—Comm. to the Board of Agriculture, Vol. VI. Pt. I.*

THE sorts of soil best adapted for this manure are stated to be dry, loamy, sandy, and gravelly soils, together with thin chalks; and stiff heavy loams with a mixture of flints, when previously chalked at the rate of seventy loads to an acre. From the middle of April to the end of May, is said to be the best time for the application of this manure, after vegetation has begun, and is slowly advancing; and the quantity used on its first introduction was six bushels to the acre, but more experience has shewn three bushels to be sufficient for sanfoin or lucerne, repeating the quantity the second or third year, if the appearance of the crop indicates the want of assistance. Gypsum may be successfully applied to lucerne, clover, sanfoin, trefoil, and all the artificial grasses; and the writer has seen a few instances where it has had a very considerable effect upon old pasture or meadow land, that had become mossy.

The effects produced are stated from experiments on sanfoin, cow-grass, Dutch clover and red clover, and are all beneficial, but the most so, on red clover. It is said to be the most effective in dry seasons, and to answer equally well on a second as on a first crop, and to continue for a considerable number of years. Many experiments are recommendad to be tried with this manure, and the names of several persons are added, who can certify the advantages of it.

Observations.—The author of this communication has published an Essay on Gypsum; and the remarks here made, are only the condensed sentiments given at large in his book on the same subject.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

Observations of a Comet, made with a view to investigate its Magnitude, and the Nature of its Illumination. To which is added, an Account of a new Irregularity lately perceived in the apparent Figure of the Planet Saturn. By WILLIAM HERSCHEL, *LL.D. F.R.S.—Phil. Trans.* 1808. *Pt. II.*

THE comet upon which Dr. Herschel made his observations was that which was seen in the autumn of 1807. From his observations on the 19th of October, it appeared to be less than the third satellite of Jupiter; its diameter being only about 1″. The Doctor's calculation makes the perihelion distance 0.647491, the mean distance of the earth being unity; its distance from the ascending node on its orbit 73° 45′ 44″; its distance from the earth on the above day, 1.169192; and its diameter 538 miles, taking the diameter of the earth, according to Mr. Dalby, at 7913.2 miles.

The observations relating to the light of the comet were made from the 4th of October to the 19th, in all which time the comet uniformly preserved the appearance of a planetary disk fully enlightened by the sun: it was every where equally bright, round, and well defined in its borders. Now, as that part of the disk which was then visible to us, could not possibly have a full illumination from the sun, the Doctor calculated the phases of the comet for the 4th, and for the 19th of October; the result of which is, that on the 4th, the illumination was 119° 45′ 9″, and that on the 19th, it had gradually increased to 124° 22′ 40″. Both phases appeared to be sufficiently defalcated to prove that the comet did not shine by light reflected from the sun only. Dr. H. then observes that, if these remarks are well-founded, we are authorized to conclude, that the body of the comet on its surface is self-luminous, from whatever cause this quality may be derived. His last observation, on the 21st of February 1808, when the comet was still a very conspicuous object, though almost 2.9 times the mean distance of the sun from the earth, and nearly 2.7 from the sun, affords additional support to the opinion of its self-illumination.

The second part of this paper relates to an irregularity in the figure of the planet Saturn. On the 16th of June 1807, Dr. H. observed a protuberance in the southern polar regions of the planet Saturn, which, he says, he is perfectly assured had no existence the last time he had examined the planet. And as the greatest

elevation of the visible segment above the ring of the planet did not amount to more than one second and three or four tenths, he ascribes the apparent irregularity in the figure of the planet to a double refraction which the rays of light coming from that part would undergo in passing through the atmosphere of the ring.

Observations.—The perihelion distance assigned by Dr. Herschel agrees very nearly with that given by Mr. Gavin Lowe, whose paper was noticed at p. 15 of our present vol. These observations of the Doctor farther establish two important circumstances; viz. that the comet consisted of a solid nucleus; and that it was self-luminous: the former being a subject of considerable doubt with most observers; and the latter constituting a further distinction between cometary and planetary bodies than has yet been pointed out by astronomers.

With regard to the apparent irregularity of the planet Saturn, as the observations appear to have no tendency to increase our knowledge of the physical constitution of the planet, the nature and properties of refraction, light, or colours, we think it was scarcely necessary to enlarge the paper by inserting them.

Eclipses of the Satellites of Jupiter; observed by JOHN GOLDINGHAM, *Esq. F.R.S. and under his Superintendence, at Madras, in the East Indies.—Phil. Trans.* 1808, *Pt. II.*

THIS paper contains dates and other elements of a great number of eclipses of the first, second, and third satellites of Jupiter, made between the years 1794 and 1802, with achromatic telescopes, made by Dollond, the magnifying power of which was between 70 and 80, and which, in conjunction with other observations, make the longitude of Madras $5^h\ 21^m$, or $80°\ 18'\ 30''$. From these observations it likewise appears, that in order to obtain a correct difference of longitude of two places from corresponding eclipses of the satellites of Jupiter, the circumstances at both places should be similar and favourable; and that the telescopes should have equal powers, or that both immersions and emersions should be observed, which, indeed, ought always to be done, where the time will admit: also, that the circumstances being favourable at one place, and not at the other, a result very different from the truth will be obtained.

Observations.—The chief advantage arising from this series of observations is a correction in the longitude of Madras of about $10'\ 15''$, as in the Requisite Tables, justly esteemed the most correct, the longitude of that place is $80°\ 28'\ 45''$. This is an

important correction, as it shews, that an error of about ten miles has been suffered to exist in the real position of Madras, situated on the western margin of the Bay of Bengal, by all preceding geographers.

Memoir on the incombustible Man: or, the pretended Phenomenon of Incombustibility. Translated from the Italian of Louis Sementini, *M. D.—Phil. Mag. No.* 125.

Dr. Sementini having heard many reports concerning Senor Lionetto, who called himself the Incombustible Man, took the earliest opportunity, and made use of the best means in his power for ascertaining the truth of these reports, by approaching as near to him as possible in witnessing his performances. The achievements of the incombustible man were the following: He put a thin plate of red-hot iron over his head, without, at least in appearance, altering his hair. He rubbed his arm and leg, and struck his heel and the point of his foot with another red-hot iron. He also held a heated iron between his teeth; and passed one red-hot over his tongue. Besides these, he bathed his fingers in liquid lead, and put this and boiling oil into his mouth. He likewise exposed his foot to the flame of burning oil, and his face to the vapours which arose from sulphuric, nitric, and muriatic acids thrown upon inflamed charcoal; and usually terminated his exhibition with passing a thick gold pin through the skin of his arm without feeling any painful sensation.

After witnessing these performances with the closest attention, and making a great number of experiments upon himself, Dr. Sementini gives the following directions for attaining a certain degree of incombustibility. The person desirous of becoming capable of sustaining the action of fire, must rub the parts to be exposed very often with dilute sulphurous acid, or with a saturated solution of boiled alum; and also with a piece of hard soap a little moistened, in order that they may acquire a degree of incrustration. With respect to the preparation of the tongue for any of the above experiments, if it be rubbed with a piece of lump sugar previously to the application of the soap, it will more effectually repel the force of caloric. And these means, united with the callousness occasioned by frequent operation, will be sufficient to render the parts to which the hot iron is applied, unsusceptible of any disagreeable sensation.

Remarks on the incombustible Man.—Phil. Mag. No. 126.

The anonymous writer of these remarks affirms that Dr. Sementini's method of preparing the tongue to resist the effects of hot iron, as described in the preceding paper, is wholly unnecessary, and that if the tongue be wet with saliva only, and the iron passed

quickly over it, the experiment may be performed with the utmost safety.

Mr. Tilloch, the editor of the Phil. Mag. also observes, that having mentioned some of the particulars respecting the incombustible man to a plumber, he was assured by him, that any one might pass his finger through melted lead without receiving any injury, provided the finger was dry, otherwise the metal would adhere to it, and the burn would be severe. The same person also informed him, that the hot poker which was passed over the tongue should be very red; for if it were only of a black heat it would certainly burn.

Observations.—Both Dr. Sementini and the anonymous author of the preceding communication appear to us to proceed *par tâtonnement* (as the French would call it): though this, perhaps, arises not so much from their incompetency, as from the difficulty and obscurity with which the subject is enveloped. Human knowledge, much as it is extended with regard to many topics, still seems prevented, as if by a repulsive force, from reaching *extremes*. We are much perplexed with many inquiries which lie at the foundation of *all* knowledge, as relative to the nature of demonstrative conviction, the grounds of rational assent, &c.; and we are equally puzzled with numerous questions pointed to the opposite extreme. Almost all we know, occupies the intermediate stations between these remote points; and, happily, almost all that is really *useful* to know covers the same space. If, for example, we could discover a process by which a man could be rendered torpid during an inclement winter, and restored to activity in the spring; or, one by which a baker could *safely* be shut up in an oven, and attend to the baking of his own bread without being *baked* himself,—such discoveries would furnish abundant food for conversation, but we do not conceive they would be of much utility. We know that in the case of the poor woman buried in the snow near Cambridge, and more particularly, in the case of the hybernal sleep of many animals, extreme cold has been endured without the extinction of life: we know also, on the other hand, that Sir Joseph Banks breathed in air heated to 211° of Fahrenheit, and Sir Charles Blagden in air at the temperature of 260°; and farther, that the oven-girls in some parts of Germany have sustained a heat of 257° for a quarter of an hour; one girl supported it ten minutes when augmented to 288°, and another breathed in air heated to 325° for five minutes without serious inconvenience*. We should be thankful if an acquaintance with these remarkable particulars had been productive of actual benefit; but, unfortunately, some of them have been known nearly half a century without leading to any discovery or invention *really useful*.

* Hist. Acad. Scienc. 1764.

The knowledge of the operation of very high or very low temperatures may, however, be of some advantage, in so far as it may, *possibly*, suggest means to be adopted in the recovery from the effects of these extremes, when by any accident men have been exposed to them. Now, here our theory is already very simple, and it points out means of practice which have been always found beneficial. We consider the mean temperature of the climate in which an individual is born, as the natural temperature of his constitution, all deviations from which are contemplated as *forced* states, as points, the return from which is always desirable, but which must never be effected *per saltum*, but *gradatim*, so as not to cause a solution of continuity. Thus, in the restoration of a frozen limb, we should first surround it with snow, then, after a time immerse it in cold water, next admit the person to a room of moderate temperature, and so on, admitting every change with great caution, and merely furnishing the sustenance proper to prevent exhaustion. On the contrary, in the case of a severe scald, we should give the injured part a moderately copious affusion of spirits of wine, or spirits of turpentine; then moisten it with a feather dipped in such spirits; next apply warm water; next, water rather cooler; and thus by preserving the law of continuity, the injured part may be brought back to the medium temperature, even in less than 24 hours, without any more *ultimate* inconvenience, than a peeling off of the cuticle similar to that experienced on recovery from a fever. Such are the methods now adopted with success by the most skilful members of the medical profession; and if we could conjecture that any advantages, with no counterbalancing inconveniencies, would arise from enabling persons to be frozen, burnt, or boiled with impunity, we conceive the most philosophical and rational preparation would be, to invert the processes described above, and thus gradually transform the constitution into what it was never intended to be—a state fitted for bearing pains, but blunted against the enjoyment of pleasures.

Method of finding the Quantity of Refraction from the Distance and Altitude of two known Stars; and of solving by Construction a Problem in Spherical Trigonometry. Anonymous.—Phil. Journ. No. 93.

Those who are conversant in topics of this nature, will readily conceive the figure here referred to, and understand the subsequent theorem. Let Z indicate the zenith, S and X the apparent, and s and x the true places of the stars, and d the difference between their true and apparent places, and $Z\,M$ part of a circle

perpendicular to the circle SX; then the refraction of the star $S = Ss$

$$= \frac{d \times \text{tang. } ZS \times \text{cos. } MS \text{ cos. } MX}{\text{sine } SX \times \text{rad.}^2}.$$

The stars should be chosen so as to make the angles S and X acute, as the cosine of an obtuse angle would be negative.

The advantages which the author of this method supposes it to possess over those which are already in common use, are, 1st, that only one observation is required, as the refraction may vary considerably in the interval between two observations; and, 2d, that it does not require the latitude to be known, and that the observation may be taken at sea with the instruments already in common use for lunar observations.

The second part of this paper explains a simple method of finding the angles of a spherical triangle, the sides of which are given. Here also the figure will be readily conceived by one acquainted with trigonometry. Let $Z\,S\,X$ be the given spherical triangle, make in another figure MI and MV = the secants of the sides ZS and ZX, including the required angle, take the angle IMV = the remaining side; let IZ, ZV = the tangents of the side ZS and ZX, and the angle IZV will be = the required angle Z.

Observations.—The resulting expression for the value of Ss, the refraction of the star S, is much too complicated to be of any real use in practice, on account of the difficulty of finding the value of d, which the author determines to be $= \frac{Ss \times \text{sine } SX \times \text{rad.}^2}{\text{cos. } MX \times \text{cos. } MS \times \text{tang. } ZS}$. And besides this, we believe if the author will examine this proportion in his demonstration, $Ss : Xx :: \text{tang. } ZS : \text{tang. } ZX$, he will find it to be inaccurate as applied to the present inquiry.

This author's graphical method of finding any angle of a spherical triangle from its sides being given, is ingenious and simple; and on comparing it with that given for the same purpose by Bishop Horsley, at page 215 of his Elementary Treatises on the fundamental Principles of practical Mathematics, it appears to be preferable.

Doubts respecting some of the received Doctrines of Chance. By Opsimath.—*Phil. Journ. No.* 91.

Some further Remarks on the Doctrines of Chance. By B. H.—*Phil. Journ. No.* 92.

Further Remarks on the Doctrines of Chance. By Opsimath; *with Remarks by the Editor.—Phil. Journ. No.* 93.

Remarks on the Doctrines of Chance, in Answer to Opsimath. By W. Saint, *Esq.*—*Phil. Journ. No.* 93.

Opsimath, in the first of these communications, admits, with De Moivre, that any one undertaking, with a die of six sides, to cast an ace in one throw, has $\frac{1}{6}$ of the 6 possible chances in his favour, and the remaining $\frac{5}{6}$ against him. He then quotes from the same author that, any one undertaking to cast an ace in two throws of one die, has, for the first probability, $\frac{1}{6}$, as proved; should the first fail, then the second remains, which is $\frac{1}{6}$ likewise; but the chance of the first failing is $\frac{5}{6}$, as that of its succeeding is $\frac{1}{6}$; therefore, the second throw is only $\frac{1}{6}$ of $\frac{5}{6}$ for its chance of success, which added to the chance of casting an ace the first throw, is $\frac{1}{6}+\frac{1}{6}$ of $\frac{5}{6}=\frac{1}{6}+\frac{5}{36}=\frac{6}{36}+\frac{5}{36}=\frac{11}{36}$; the first throw being $\frac{6}{36}$, the second only $\frac{5}{36}$.

This doctrine, however, Opsimath refuses to grant; his reasons for which he states as follows. Nothing can prevent him of the second throw, except his succeeding in the first; therefore, either he has no occasion for it, or he has it in all its full force and virtue of $\frac{1}{6}$ chance, from which no circumstance can deduct. Otherwise it must be denied, that two equal chances are twice as good as one; and by summing up, according to De Moivre's rules, the probability of casting an ace in six throws of one die, it will be found that they are below $\frac{6}{6}$, to which they should, of course, amount, being the assumed sum of certainty on the event, upon an average of trials.

Mr. B. H's reply to Opsimath not being deemed satisfactory, induced him to offer a farther illustration, in the third of the above papers, of what he had advanced in the first of them. But as the answer, by Mr. Saint, contained in the last of these articles, is the most complete and important, we shall give a summary of its contents, in preference to entering into any detail respecting either of the two preceding papers.

Mr. S. shews that Opsimath's supposed quotation from De Moivre, that the whole six chances being certainty, or at least such, in the event of continued trials, is not correct; as it is not to be found in the first, or any other case of De Moivre's work; nor can it be inferred from any thing which that author has said on the subject. Indeed, had Opsimath proceeded a few pages further than the place whence his supposed quotation is taken, he would have observed that De Moivre says, let a be the number of chances for the happening of an event, and b the number of chances for its failing, then the probability of its happening once in any number of trials will be $\frac{a}{a+b}+\frac{ab}{\overline{a+b}\,|^2}+\frac{ab^2}{\overline{a+b}\,|^3}+$ &c. till the number of terms be equal to the number of trials given.

The application of this to the present case gives $\frac{31031}{46656}$ for the

probability of throwing an ace once in six throws; whereas, Opsimath infers, and infers justly, had the expression which he attributes to De Moivre been correct, that $\frac{6}{6}$, or certainty, would be the amount of the probability. Mr. S. then proceeds to answer the objections contained in the first of the communications, the titles of which are given at the beginning of this article; but as these scruples appear to have originated in the error of supposing the six chances to be equal to certainty, we shall not follow him through the other parts of his answer; especially, since the most ingenious part of his paper, and that which is by far the most valuable to our readers, is a curious problem relative to the credibility of testimony, which he has given in elucidation of the doctrines of chance. This we shall give, with its solution and corollaries.

Question.—A, with a truths, tells b falsehoods, and B with c truths, tells d falsehoods; what is the probability of the truth of a circumstance in which they both agree?

Solution.—As they are supposed to *agree* in their relation, they must either *both* speak truth, or *both* falsehood. Since then the probability of an event's happening, is always expressed by the quotient of the number of times in which it may happen, divided by the number of times in which it may both happen and fail, it is evident, that, in the present case, the probability of a circumstance being true, in which both of them agree, will be expressed by the quotient or the number of times in which they may agree in telling truth divided by the number of times in which they may agree in telling both truth and falsehood. Now the number of times in which they may agree in telling truth, will be the number of combinations of a in c, viz. ac (for each of the truths a may be told with each of the truths c); and for the same reason, the number of times in which both of them may agree in telling falsehood, will be bd; the true expression, therefore, for the probability required will be $\frac{ac}{ac+bd}$.

Cor. 1. Let a, b, c, and d, be all equal to each other, then will $\frac{ac}{ac+bd}=\frac{1}{2}$. Now the probability of A's telling truth is expressed by $\frac{a}{a+b}$, which will also $=\frac{1}{2}$; hence the probability of the truth of a circumstance in the relation of which two persons agree who are each in the habit of relating truths as often as falsehoods, will be the same as if related by either of them separately.

Cor. 2.—If a be greater than b, and c greater than d, then will $\frac{ac}{ac+bd}$ be greater than either $\frac{a}{a+b}$ or $\frac{c}{c+d}$; for $\frac{a}{a+b}=\frac{ac}{ac+bd}$, and $\frac{c}{c+d}=\frac{ac}{ac+ad}$. Now since a is greater than b, and c

greater than d, the denominators $ac+bc$ and $ac+ad$ to the common numerator ac will be each of them greater than $ac+bd$, and consequently the value of the fractions less than $\frac{ac}{ac+bd}$; viz. the probability of a circumstance being true in the relation of which two persons agree, who are each in the habit of relating more truths than falsehoods, will be *greater* than when related by either of them separately.

Cor. 3. If a be less than b, and c less than d, then $\frac{ac}{ac+bd}$ will be less than either $\frac{a}{a+b}$ or $\frac{c}{c+d}$; viz. the probability of the truth of a circumstance in the relation of which two persons agree, who are each in the habit of relating fewer truths than falsehoods, will be *less* than when related by either of them separarely.

Cor. 4. If a be either greater or less than b, and $c=d$, then will $\frac{ac}{ac+bd}=\frac{ac}{ac+bc}=\frac{a}{a+b}$; viz. the probability of the truth of a circumstance in the relation of which two persons agree, the one of whom is in the habit of relating an equal number of truths and falsehoods, and the other any number of truths with any number of falsehoods, will be the same as if related by *that other only*.

Cor. 5. If $d=o$, then $\frac{ac}{ac+bd}=\frac{ac}{ac}=1$ or certainty; viz. the probability of the truth of a circumstance in the relating of which two persons agree, the one of whom uniformly relates truth, and the other any number of truths with any number of falsehoods, will always amount to certainty: as is evident from reflection also, for, in this case, *to agree* they must *both* speak truth.

Cor. 6. Hence also it appears, that the corroborating testimony of a second person, or witness, is not *always* an additional evidence in favour of the truth of a circumstance related by the first, for if d be greater than c, bd will be greater than bc, and consequently $\frac{ac}{ac+bc}\left(\text{or its equal } \frac{a}{a+b}\right)$ will be greater than $\frac{ac}{ac+bd}$; viz. the probability of the truth of a circumstance is greater if related by *one person only*, than if related by *two*, when the second is in the habit of relating a greater number of falsehoods than truths.

Cor. 7. Lastly, if the relations be supposed to be *untold*, or, in other words, if it be supposed that A and B are each *about* to relate a circumstance, the probability that they will both speak truth will be expressed by $\frac{ac}{(a+b)\times(c+d)}=\frac{ac}{ac+ad+bc+bd}$; for

the probability of A's speaking truth would be $\frac{a}{a+b}$, of B's speaking truth $\frac{c}{c+d}$, and therefore of both $\frac{ac}{(a+b)\times(c+d)}$.

Observations.—The mistake into which Opsimath has here fallen, is essentially the same as that made by M. *Condorcet*, when inquiring into the laws regulating the decisions of deliberative assemblies, a mistake which seems to have arisen from not properly distinguishing between dependent and independent events. We conceive, however, that either Opsimath or any other person properly qualified, will have very few doubts remaining on this subject, if he will carefully read, and clearly comprehend, the principal propositions contained in the work of De Moivre, so often referred to in these papers. However, as the subject in its connexion with the credibility of human testimony is curious and interesting, we shall avail ourselves of this opportunity to add a few remarks.

Our experience of a course of nature, is not always proportionate to the number of experiments *in a given instance*, though it is undoubtedly proportionate to the whole number of experiments upon which our belief is founded. Thus, if a new metal be discovered which is specifically heavier than lead, we conclude, with confidence, from that single experiment, that it, as well as lead, upon which we have made so many experiments, will sink in water. And our confidence in this respect arises from our transferring to this particular circumstance the sum of our experiments on other substances specifically heavier than water, and which we have uniformly observed to sink in it. And it is from a similar cause that the regard we pay to the report of a witness is not always in proportion to the number of truths we have known *him* relate; because we apply to him the sum of all those instances of veracity which we have observed in others.

As our belief in a course of human nature, and a confidence in human testimony, are equally derived from experience, and as any given degree of probability is proportional to the number of previous experiments, and is capable of being justly expressed by a fraction which denotes the value of our expectation; hence it follows, that probabilities of this nature which are derived from experience respecting either the phenomena of nature, or the veracity of human testimony, are homogeneous quantities; and will, therefore, bear a just comparison with each other. But the conviction produced by testimony is susceptible of being carried to a much *higher* degree than that drawn from other kinds of experience; because there may be concurrent testimonies respecting the truth of the same individual fact, but there cannot be any concurrent experiments relative to an individual experiment.

There may, however, be analogous experiments as well as analogous testimonies; but in a course of nature there is only one continued series of events, while in human testimony, the same event may be observed by a great variety of different witnesses, the concurrence of whom is capable of producing a more powerful conviction than that which is obtained by observing any other species of events in the course of nature. The probability of an expected event, relating to material phenomena, depends entirely upon analogous experiments, which may have been made previously to the happening of that event; and as the number of these precedent experiments is unlimited, the probability will therefore admit of an indefinite increase. The credibility of a witness arises likewise from our experience of the veracity of previous witnesses, and it also admits of an unlimited increase proportionate to their number; the law of this increase being the same with that derived from a series of physical events. There is, however, another source of unlimited increase of human testimony, arising from the number of *concurrent* witnesses, and in which the case of increase is different from the former. The evidence of testimony, therefore, admitting of an unlimited increase on two different accounts, and the probability of the happening of any specific event admitting only of one of them, the former is capable of indefinitely surpassing the latter.

Those who wish to pursue this subject may peruse a very ingenious Paper on human credibility in No. 257, vol. xxi. of the *Philosophical Transactions.*

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1. *Observations on the Hypotheses which have been assumed to account for the Cause of Gravitation from mechanical Principles. By the Rev.* S. Vince, *A.M. F.R.S. Plumian Professor of Astronomy and experimental Philosophy at Cambridge.* 1806.
2. *Remarks on a Pamphlet lately published by the Rev. S. Vince, respecting the Cause of Gravitation. By* Dytiscus.—*Ph. Journ. No.* 84.
3. *Answer to Remarks on a Pamphlet lately published by the Rev. S. Vince.—Ph. Journ. No.* 85.
4. *Further Remarks on Professor Vince's Answer.—Ph. Journ. No.* 87.
5. *Letter from Professor* Vince, *in Reply to Dytiscus.—Ph. Journ. No.* 88.
6. *Reply to Professor Vince's Ultimatum.— Ph. Journ. No.* 89.
7. *Criticisms on Professor Vince's Pamphlet.—Edinb. Rev. No.* 25.
8. *Remarks on a Review of Professor Vince's Essay.—Ph. Journ. No.* 94.

This controversy between Professor Vince and his anonymous opponent, who has undertaken to defend the decision of the

Council of the Royal Society, has excited, from the celebrity of the parties concerned, no inconsiderable share of the attention of those who are attached to the mathematical sciences. Professor Vince has endeavoured to shew, in his Essay, which was read before the Royal Society as the Bakerian Lecture for 1804, that the hypothesis suggested by Newton for explaining the proximate cause of gravitation, by the pressure of an ethereal medium, is not only physically improbable, but also mathematically impossible; and he is disposed to infer that the general cause of gravitation must be purely spiritual, and that this property of matter is dependent not only on the creative fiat, but even on the continued agency of the Deity. The paper not having been printed in the Philosophical Transactions, the author considers himself as illiberally treated by the President and the Council of the Society, and has prefixed to his publication a statement of the circumstances attending its rejection. These circumstances his antagonist has attempted to explain, at the same time that he has endeavoured to point out some imperfections in Mr. Vince's mathematical arguments. It will not be necessary for us to enter into all the particulars of the controversy, and we shall wholly refrain from noticing any thing which is of a personal nature: the peculiarity of our plan obliges us to be brief, and for this reason, as well as for many others, we wish to exclude every thing which is not of immediate importance to the promotion of science. We shall endeavour to state the principal arguments which have been advanced, as much as possible in the words of the authors, and shall conclude with a very few observations of our own.

1. Mr. Vince first states, in a cursory manner, the imaginations of Kepler, Descartes, J. Bernoulli, and Huygens; and mentions also, in a few words, the hypothesis of Lesage, adopted by Saussure. After having enumerated the obvious difficulties of these theories, he examines Sir Isaac Newton's supposition of an ethereal medium, increasing in density as its distance from the sun and from any of the planets becomes greater; and causing, by its superior pressure on the remoter part of any gravitating body, the phenomena of an attractive force, tending towards the sun or planet. Mr. Vince then proceeds to calculate the total result of the pressure on a sphere of finite magnitude, upon various suppositions respecting the constitution of such a medium. He determines the fluxion of the pressure on the remoter part of the surface in an infinite series, of which he employs two terms only, "omitting, for the present, all the other terms of the series, as being so extremely small in comparison with the two first;" he then subtracts from this fluxion that of the force acting on the nearer side of the sphere, and obtains, for the whole fluent of the result, "$\frac{2m-mn}{3} r^3 a \frac{\frac{2m-mn}{2}}{-1}$," the whole force with which

the planet is urged towards the sun"; a being the distance of the centres, r the radius of the sphere, m the power of the distance which expresses the density of the fluid as "measured by the number of particles uniformly diffused on a given square area," and n the power of the distance of the particles according to which their elastic force varies. From the moving force thus determined, the accelerating force is deduced, dividing it by er^3, e expressing the density: and it is shewn that no one value of m, the power of the distance, will afford a force varying in the manner of gravitation. The author then proceeds to inquire whether any "other law of density, which is compounded of different powers of the distance, may be made to agree with the law of gravity. Let us therefore represent the density of the medium," he continues, "by $Pa^m + Qa^q + Ra^s +$, &c.; for by taking a proper number of these terms, this quantity may represent any variation of density, depending upon the variation of the distance. Hence, according to the foregoing reasoning, taking only the two first terms of the series, the law of force tending to the sun is $P\frac{2m-mn}{3e}a^{\frac{2m-mn}{2}-1} + Q\frac{2q-qn}{3e}a^{\frac{2q-qn}{2}-1} + R\frac{2s-sn}{3e}a^{\frac{2s-sn}{2}-1}$ + &c. Now these being different powers of the distance a, the whole can never constitute a power which varies as $\frac{1}{a^2}$; and much less if we take in the terms which were omitted." He concludes, "that it is not possible for any law of variation of the density of the fluid in terms of the distance from the sun, combined with any law of variation of the repulsive force of the particles of the fluid in terms of their distance, to satisfy the law of gravitation." He then states the difficulties attending the permanent existence of such a fluid, in any state that might be supposed capable of producing the effects, the interference of the mediums belonging to different gravitating bodies with each other, and the resistance by which the planets would be retarded in their revolutions: and from all these considerations of the objections to the operation of mechanical causes in the "preservation" of the planetary system, he thinks "we ought to conclude, that the Deity, in his government, does not act by such instruments, but that the whole is conducted by his more immediate agency, without the intervention of material causes."

2. Mr. Vince's anonymous opponent Dytiscus observes, in his first Remarks, that if, in the series assumed for the variation of the density of the medium, we make $m=0$, and $R=0$, the expression for the force will become simply $Q\frac{2q-qn}{3e}a^{\frac{2q-qn}{2}-1}$, and that the power of the distance a may become -2 on many suppositions, while the density is expressed by two terms of the

first series. The omission of this consideration he calls a palpable blunder, and observes that "there appears to be another mistake in Mr. Vince's calculations;—Mr. V. says, "let the density be as d^m, then the distance of the particles is as $\frac{1}{d_2^m}$" instead of $\frac{1}{d_3^m}$, as Newton has stated it. The remainder of the paper contains an explanation and defence of the conduct of the Council of the Royal Society.

3. Professor Vince in reply asserts, that "the force was represented by the sum of the alternate terms of the binomial theorem; in this particular case, therefore," he says, "we take the two first terms only, as is here proposed. But in the present article we represented the density by $Pa^m + Qa^l + Ra^r +$ &c. each of which terms gives a series for the force, similar to that stated above; here, therefore, according to the same proceeding, we take the two first terms of each of these series;" so that still "the whole could not constitute a quantity which should vary, as $\frac{1}{a^2}$." Even if the objection had been well-founded, he thinks that it would have proved nothing against his proposition, since the density e enters into the expression for the force: and in the case suggested, where $m=o$, the force must be represented by $\frac{\alpha}{a^2} + \frac{\epsilon}{a^4} + \frac{\gamma}{a^6} +$ &c.; and can this, he says, vary as $\frac{1}{a^2}$, even omitting e? Besides, upon the supposition stated, the density of the medium would become negative at a certain point within the attracting substance, and there could be no gravitation near the centre of the sun. To the second objection, respecting the power of the distance representing the density, he answers, that the nature of his proposition necessarily obliged him to measure the density by the quantity of matter on a given plane, and that this is no new use of the term density, since it is so employed when we say that the density of light and heat varies inversely as the square of the distance. He thinks that his adversary did not read his whole Essay, but merely "looked amongst the expressions, to see, if by assuming particular values of the quantities, he could not prove against the proposition."

4. Dytiscus answers, in his Further Remarks, that "the two first terms of the series" *must* be understood of the *only* two series which are to be found in the Essay: two of these four terms destroying each other, and the other two being united in the expression which is laid down for the force: that the series to which Mr. Vince applies the words in his Answer, is not even mentioned in the Essay: that the author had expressly asserted the sufficiency of a single term for his purpose: that the series $\frac{\alpha}{a^2} + \frac{\epsilon}{a^4} + \ldots$ may vary as $\frac{1}{a^2}$, if all the Greek letters

after the first become inconsiderable: that the law of the density, like that of the force, must change at the surface of the attractive body: that the density of the body attracted does not require to be considered, since the spheres concerned can only be the ultimate atoms of matter, and not the material aggregates which they compose. With respect to his second objection, he says that it could not be necessary to employ the term density, for what ought to have been called the square of the cube root of the density: that the density of light and heat may be truly measured in the manner mentioned by Mr. Vince, but not that of an elastic medium.

5. In Professor Vince's second Reply, he maintains that his opponent has misrepresented him where he asserts that *only two* series are to be found in the Essay; since he has "put down the first terms of *three* of the series, with + &c., meaning, of course, that the other series and terms were to be supplied:" and that "he never mentioned that the two terms alluded to are sufficient to determine the force." He says that the series $\frac{\alpha}{a^2} + \frac{\beta}{a^4} + \frac{\gamma}{a^6} \ldots$ can *not* vary as $\frac{1}{a^2}$; the quantities β, γ, being still finite, though very small, while the law of gravity varies *accurately* as $\frac{1}{a^2}$: by changing the law of the variation of density at the surface of the body, he asserts that we substitute two fluids instead of one, and that in doing this we make a change in the Newtonian hypothesis.

6. Dytiscus in his last Letter insists that, although "*three quantities* are put down" in the Essay, which the Professor now calls "the first terms of three series," yet these *series* are no where mentioned in the original work: he quotes Mr. Vince's words, that if the terms omitted were not considered, "they could make no sensible alteration in the result:" he asserts that, mathematically speaking, we have not the slightest evidence that the law of gravitation *varies accurately* as $\frac{1}{a^2}$, and that in a physical sense, the series in question may undeniably vary in that proportion. The change of the law of density below the surface, he considers as the unavoidable consequence of Newton's hypothesis, since the state of the medium must be supposed to depend on some influence exerted on it by the particles of matter, and since the combined influence of several particles in different situations, must be very different from the influence of a single particle: not that he attempts to defend the probability of so complicated an operation of the causes of gravitation, but merely to shew that Professor Vince has attacked it unsuccessfully, and defended himself ineffectually.

7. The author of the article in the last number of the Edinburgh Review seems to have gone over nearly the same ground on which Dytiscus had stood some time before. He is, however, so far from being aware of the coincidence, as to confess that he discovered the fallacy of Professor Vince's argument, after he had begun his criticism under the impression of its accuracy. He says that, "though a variation of density or of elasticity, expressed thus, $Ax^m + Bx^n$, cannot take place, because the force arising from it would also involve two terms, yet, if one of the terms be constant, as if $m = 0$, and so the expression $= A + Bx^n$, then the force would be expressed by one term only, viz. by the fluxion of Bx^n, that is, by a quantity proportional to x^{n-1}." He then makes a substitution which exemplifies the possibility of such a constitution of an elastic medium, although not in the simplest manner. He enlarges considerably on other hypotheses which have been proposed with similar views, and which have been but slightly mentioned by Mr. Vince; and he is inclined to give a decided preference to that of Lesage, who conceives that prodigious numbers of small particles are passing continually through every point of space, with a velocity incomparably greater than that of light, and that these gravific atoms impel the particles of gravitating matter in such a manner, as to produce all the phenomena of an attractive force, increasing as the square of the distance decreases. But he still very properly remarks, that the system of Boscovich, which has not been mentioned by Mr. Vince, is calculated to produce great uncertainty in all our speculations respecting the effects of impulse; since it gives us reason to doubt whether impulse, in the strictest sense of the term, is a possible occurrence.

8. On this review, Professor Vince observes in a short note, that "the fluxion of the elasticity is no solution of the problem he proposed to answer," which relates to a body of finite magnitude: and still insists on the necessity of distinguishing between the accelerative and the moving force, that is, in other words, of taking into consideration the density of the body.

Observations.—In a case like the present, it would be inexcusable presumption in us to attempt to pass a definitive sentence: the statement which we have laid before our readers, is as impartial as it was in our power to make it, and we trust that they will be able to form from it some judgment of their own. The coincidence of the objection made by the reviewer with the first of those which had been advanced by Dytiscus, must add some weight to the argument, even in the opinion of those who are not disposed to allow a high degree of authority to the decisions of the Edinburgh Review. Nor can we suspect that the writer of the article was acquainted with any part of the controversy between Mr. Vince and his first opponent; since it is not to be

imagined that the authors of this publication should think it necessary to invent a misrepresentation of the progress of their own minds, in the private history of their "Vindication of Newton," merely in order to convince the public that they are capable of *changing their opinion*, even on a *mathematical* question. We cannot, however, help admiring their *unchangeable* adherence to the fundamental principle expressed in their motto: ever fearful of "acquitting the guilty," they refrain from pronouncing any judgment, where that judgment must be more favourable than they desire; and although they censure Professor Vince's Essay from beginning to end, they refuse to acknowledge that the Council of the Royal Society did right in declining to print it. Professor Vince's reply to the first objection is partly an attempt to affix a meaning to his words, different from that in which they have been understood, and partly a defence of the meaning thus assigned to them: the point which remains at issue between Professor Vince and both of his antagonists, is this; whether the general law of gravitation is mathematically, or only physically accurate. The second objection of Dytiscus appears to be, in some measure, abandoned by its author; and we think it never ought to have been advanced as relating to a mathematical error: we have no doubt that this objection arose from an attempt to substitute for a certain term or quantity, without attending to the precise sense in which that term was employed by the author: but, on the other hand, we cannot consider it as *judicious* in Professor Vince to have used the term density in such a sense as would render it necessary to express the well-known law, that the elasticity of every elastic fluid, with which we are acquainted, is proportional to its density, by saying that the elasticity varies as *the cube of the square root* of the density; such a departure from established usage being always extremely likely to produce the inconvenience which, in this case, has actually arisen from it.

Hydraulic Investigations, subservient to an intended Croonian Lecture on the Motion of the Blood. By THOMAS YOUNG, *M. D. For. Sec. R.S.—Phil. Trans.* 1808. *Pt. II.*

DR. Young's object in this paper is, to investigate minutely and comprehensively, the motions of fluids in pipes, as affected by friction, the resistance occasioned by flexure, the laws of the propagation of an impulse through the fluid contained in an elastic tube, the magnitude of a pulsation in different parts of a conical vessel, and the effect of a contraction advancing progressively through the length of a given canal.

I. *Of the Friction and Discharge of Fluids running in Pipes, and of the Velocity of Rivers.*

After remarking that the form of the expressions given by Chevalier Dubuat for this purpose, is not so convenient for prac-

tice, as it might have been rendered, and that these expressions are not true, when the pipe is either very narrow or extremely long; this author observes that, by comparing the experiments which Dubuat has collected with some of Gerstner's and some of his own, he has discovered a formula, which extends to all cases, which appears to represent more simply the actual operation of the forces concerned, and which is direct in its application to practice. It appeared to Dr. Y. in the course of his investigation, that the friction could not be represented by any single power of the velocity, and that it frequently approached to the proportion of that power of which the exponent is 1.8; but it seemed to consist of two parts, one of them varying simply as the velocity, and the other as its square. The former of these parts is less than the latter in large pipes, but greater than it is in very small tubes; the latter also increases for any given portion of the internal surface of the pipe as the diameter diminishes.

By denoting the height which is employed to overcome the friction by f, the velocity per second by v, the diameter of the tube by d, and in its length by l, it is found that $f = a\frac{l}{d}v^2 + 2c\frac{l}{d}v$; and that $a = \cdot 0000001\left(430 + \frac{75}{d} - \frac{1440}{d+12} - \frac{180}{d+\frac{1}{3}}\right)$, and $c = \cdot 0000001\left(\frac{900\,da}{dd+1000} + \sqrt{\frac{1}{d}}\left(1050 + \frac{12}{d} + \frac{\cdot 9}{dd}\right)\right)$; where all the measures are expressed in French inches. From this, the velocity of any given pipe or river, with any given head of water, is readily calculated. For, as the height necessary to produce the velocity, independent of friction, according to experiment, is $\frac{v^2}{550}$; therefore the whole height of the head h is equal $f + \frac{v^2}{550}$, or $h = \left(\frac{al}{d} + \frac{1}{550}\right)v^2 + \frac{2cl}{d}v$: by making $b = \frac{1}{al : d + \cdot 00182}$, and $e = \frac{bcl}{d}$, $v^2 + 2ev = bh$, we shall obtain $v = \sqrt{(bh + e^2)} - e$. This formula is adapted to rivers by supposing l infinite; in which case b becomes $\frac{d}{al}$, and $bh = \frac{d}{a} \cdot \frac{h}{l} = \frac{ds}{a}$, s being the sine of the inclination, and d four times the hydraulic mean depth: and, since in this case $e = \frac{c}{a}$, $v = \frac{\sqrt{(ads + cc)} - c}{a}$, and in most rivers, v becomes nearly $\sqrt{(20000\,ds)}$.

Having compared a great many experiments with his theory, for the purpose of ascertaining its accuracy, Dr. Young concludes that the mean error of his formula is about $\frac{1}{25}$ of the whole velocity. He then reduces the measures into English inches,

whence $a = \cdot0000001\left(413+\frac{75}{d}-\frac{1440}{d+12\cdot8}-\frac{180}{d+\cdot355}\right)$,

$c = \cdot0000001\left(\frac{900dd}{dd+1136}+\frac{1}{\sqrt{d}}\left(1085+\frac{1321}{d}+\frac{1.0563}{dd}\right)\right)$,

and $b = \frac{1}{al:d+.00171}$, e and v being expressed in general terms the same as before.

It is then observed, that the superficial velocity of a river may be found, very nearly, by adding to the mean velocity v its square root, and the velocity at the bottom by subtracting it.

Table of Coefficients, for English Inches.

d	a. $.1^7+$	c $.1^7+$	d	a. $.1^7+$	c $.1^7+$	d	a. $.1^7+$	c $.1^7+$	d	a. $.1^7+$	c. $.1^7+$
∞	413	900	40	383	698	4	306	556	.4	254	1779
500	410	944	30	377	597	3	292	635	$\frac{1}{3}$	268	1963
400	409	948	25	371	526	2.5	284	694	.3	280	2082
300	406	951	20	364	482	2.	277	774	$\frac{1}{4}$	305	2307
200	404	951	15	354	430	1.5	266	894	.2	354	2631
100	399	918	10	339	413	1	251	1099	$\frac{1}{6}$	409	2943
90	398	903	9	336	421	.9	248	1161	.15	447	3150
80	396	885	8	331	433	.8	245	1234	$\frac{1}{7}$	466	3251
70	393	860	7	327	449	.7	243	1322	$\frac{1}{8}$	528	3558
60	391	825	6	322	471	.6	243	1433	$\frac{1}{9}$	599	3866
50	389	772	5	312	507	.5	245	1578	.1	657	4183

II. *Of the Resistance occasioned by Flexure in Pipes or Rivers.*

The calculation in this part of the paper is founded upon the supposition that the effect of the curvature increases as the curvature increases, and that the retardation is inversely proportional to the radius of curvature, or nearly so. And the mode of computation differs from those previously used for the same purpose, by attending merely to the angles of flexure as expressed in degrees, instead of either the sines or the squares of the sines of those angles. The resulting formula for the retardation is $r=\frac{pv^2}{200000q}$, p being the number of degrees subtended at the centre of flexure, and q the radius of curvature of the axis of the pipe, in French inches; but as the resistance increases more nearly as that power of the radius of curvature of which the index is $\frac{7}{8}$ diminishes, a more accurate expression will be $r=\frac{\cdot0000045pv^2q^{\frac{1}{8}}}{q}$.

From comparing this formula with experiment, Dr. Young infers that the error is about $\frac{1}{25}$ of the whole.

III. *Of the Propagation of an Impulse through an elastic Tube.*

As the forces concerned in the propagation of an impulse through an incompressible fluid contained in an elastic pipe are precisely similar to those which are employed in the transmission of an impulse through an elastic solid or fluid body, the same reasoning is here made use of in determining the former, as is generally employed in ascertaining the latter. Let the diameter of an elastic pipe in its most natural state be represented by a, and this diameter be increased to b, by the pressure of the fluid column c; then the constitution of the tube or pipe being such that its tension may vary as the force, the height c will vary as $\frac{b-a}{b}$; and when the diameter of the tube is enlarged to any other magnitude x, the corresponding pressure which distends it, will be expressed by a height of the column equal to $\left(1-\frac{a}{x}\right).\frac{bc}{b-a}$. If x be supposed infinite, the height capable of producing the necessary pressure becomes $\frac{bc}{b-a}$; and by putting this equal to g, for every other value of x, the height is $g-\frac{ag}{x}$. And if two values of x, with their corresponding heights, be given, as b and x, corresponding to c and d, and the value of a be required, we shall have $= \frac{dbx-cbx}{dx-cb}$; and therefore $\frac{b}{a} = \frac{dx-cb}{dx-cx}$.

The velocity of the propagation of an impulse, Dr. Y. determines to be equal to the velocity which a body would acquire by falling through the height $\frac{1}{2}\left(\frac{a}{2x}.\frac{bc}{b-a}\right) = h$: and observes that h is always equal to half the difference between g and the actual height of the column above the given point, or to half the height of the point above the base of the column.

IV. *Of the Magnitude of a diverging Pulsation at different Points.*

The result obtained on this subject is the same as that previously known for the transmissions of impulses through elastic bodies; viz. that the intensity of the impulse varies inversely in the subduplicate ratio of the extent of the parts affected at the same time. A very singular exception to the general law of the preservation of ascending force, in the case of waves crossing each other, is here pointed out as deserving the attentive consideration of those who would either investigate the more refined parts of hydraulics, or the metaphysical principles of the laws of motion.

V. *Of the Effect of a Contraction advancing through a Canal.*

If the end of a rectangular horizontal canal, partly filled with water, be supposed to advance with a given velocity, less than that with which a wave naturally moves on the surface of the water, a certain portion of the water will be carried forwards, with a surface nearly horizontal, and the extent of this portion will be determined, very nearly, by the difference of the spaces described, in any given time, by a wave moving on the surface thus elevated, and by the moveable end of the canal. If the velocity of the moveable end of the canal be represented by v, the original depth by a, the increased depth by x, and the velocity of the anterior part of the wave by y; then, when the wave has become considerable, $x = \frac{ay}{y \mp v}$, the negative or positive sign being taken according to the direction of the motion of the end. But as the quantity of fluid which before occupied the length expressed by y, now occupies the length $y \mp v$; by putting $a - x = z$, $z = \frac{av}{y \mp v}$: and when v is small, the space through which a body must fall to acquire the velocity v, denoted by b, and m assumed the same for a wave, as for the discharge through an aperture, we shall have $y \mp v = m\sqrt{\frac{a}{2}}$ nearly, $z = \sqrt{(2ab)}$, and $x = a \pm \sqrt{(2ab)}$, while the height of a fluid in which the velocity would be y, is nearly $a \mp \frac{1}{2}\sqrt{2ab}$: in this case, however, where v is comparatively small, y may be taken, without material error, equal to $m\sqrt{\frac{x}{2}}$, or even $m\sqrt{\frac{a}{2}}$, which is the velocity of every small wave.

If the moveable end of the canal remain open at the lower part for the height c, then the excess of pressure, occasioned by the elevation before it, and the depression behind, will cause the fluid, immediately below the moveable plane, to flow backwards, with a velocity determined by the height which is the difference between the levels; and if the canal end abruptly, at the part from which the motion begins, the elevation z will be to the depression as v to $y - v$; but if it be continued backwards without limit, the proportion will be as $y + v$ to $y - v$: and the difference of the levels will be $h + z\frac{y-v}{v} = \frac{zy}{v}$ in the first case, and $z + z\frac{y-v}{y+v} = \frac{2zy}{y-v}$ in the second. Whence, by proper substitution and the resolution of a quadratic equation, z may be determined.

It is then remarked, that if v be great in comparison with

$m\sqrt{\frac{a}{2}}$, the velocity of a wave, and the space c small, the anterior part of the elevation would advance with a velocity considerably greater than the natural velocity of the wave: but when c bears a considerable proportion to the whole height, the elevation z will be small. And a similar mode of reasoning may also be applied to a contraction moving along an elastic pipe.

These Investigations then conclude with thus determining the velocity of a wave of finite magnitude. Let the depth of the fluid be a, and suppose a section of the wave to be an isosceles triangle, of which the height is b, and half the breadth c: then the force urging any thin vertical lamina in a horizontal direction, will be to its weight as b to c, and the space d, through which it moves horizontally, while half the wave passes it, will be such that $(c-d)(a+\frac{1}{2}b)=ac$, whence $d=\frac{bc}{2a+b}$. But the final velocity in this space is the same as is due to a height equal to the space, reduced in the ratio of the force to the weight, that is, to the height $\frac{bb}{2a+b}$, and half this velocity is $\frac{1}{2}m\sqrt{\frac{bb}{2a+b}}$, which is the mean velocity of the lamina. In the mean time, the wave describes the space $c+d$, and its velocity is greater than that of the lamina in the ratio of $\frac{c}{d}+1$ to 1, that is $\frac{2a+b}{b}+1$ or $\frac{2a}{b}+2$ to 1, becoming $m\left(\frac{a}{b}+1\right)\frac{b}{\sqrt{(2a+b)}}=m\frac{a+b}{\sqrt{(2a+b)}}$; which, when b vanishes, becomes $m\sqrt{\frac{a}{2}}$, as in LAGRANGE's theorem, and, when b is small, $m\left(\sqrt{\frac{a}{2}}+\frac{3}{4}\frac{6}{\sqrt{(2a+b)}}\right)$ or $m\frac{a+\frac{3}{4}6}{\sqrt{2a}}$; but if a were small, it would approach to $\sqrt{b}$, the velocity due to the whole height of the wave.

Observations.—On examining the formula which Buat had deduced from his investigations on this subject, Dr. Young perceived that they did not possess that degree of convenience, and that generality which is so desirable in formulæ of this nature; and his object appears to have been to obtain formulæ more general, more natural, and more direct in their application than those given by Buat; and his labours have not been destitute of success.

Buat's formula has the advantage of being simpler in its expression, and more easily committed to memory, but Dr. Young's seems to be more convenient in its application, and more susceptible of being accommodated to any future experiments: in cases were Buat's formula will apply, both are nearly equal in point of accuracy. With respect to the retardation of a

fluid passing through bent pipes, we believe the only rule known prior to Dr. Young's investigations, was deduced from experiments made with pipes of one inch diameter only, and this rule was even applied to rivers; but Dr. Young has deduced his formula from a series of experiments on both one inch and two inch pipes: yet a much greater variety of experiments with tubes of different diameters is still necessary, either to corroborate this formula in its present state, or to impart to it a greater degree of accuracy. Buat's rule on this subject, owing to the erroneous principles from which it was obtained, appears wholly incapable of affording results that may be depended upon; therefore, the formula given in the present instance, is the only one that is of any value: and we should be glad if either Dr. Young, or any other person, would favour the public with such experiments on tubes of this description as would render it more satisfactory, by establishing it upon a broader basis.

Remarks on Mr. Gough's Essay on polygonal Numbers. By P. Barlow, *Esq.—Phil. Jour. No.* 92.

Answer to Mr. Barlow's *Remarks on the Essay on polygonal Numbers. By* J. Gough, *Esq.—Phil. Jour. No.* 94.

This controversy relates to Mr. Gough's paper on polygonal numbers, which we noticed at page 297 of our 15th Number. In Mr. Barlow's estimation, as well as in ours, Mr. Gough's demonstration is not satisfactory; and he has urged several objections to it, to which Mr. G. has replied, as the title of the second of these papers indicates. But as we do not conceive that this controversy is sufficiently interesting to our general readers to induce us to enter into any particulars respecting it, we shall only observe, that, in our opinion, Mr. Gough, with regard to Mr. Barlow's principal objection, by attempting to prove too much, proves nothing.

Observations on the Problem respecting the Radius of Curvature. By W. Moore, *Esq.—Phil. Jour. No.* 94.

This is an attempt to shew, that the nature of the problem respecting the radius of curvature does not involve in it the consideration of second fluxions, but that they are made to enter into the definitive expression as a matter of mere convenience. Mr. M. first finds the radius of curvature $BD = \frac{v\dot{z}}{\dot{x}}$; where x denotes the absciss, z the curve, v the corresponding ordinate of the osculatory circle. But this general expression for the radius of curvature being in terms of the ordinate of the *circle*, it requires to be changed

into an expression in fluxional terms of the absciss and ordinate of the curve. Mr. M. has therefore made the transformation, and obtains $BD=\frac{-\dot{y}\dot{x}\cdot\overline{\dot{x}^2+\dot{y}^2}^{\frac{3}{2}}}{\dot{x}^3\ddot{x}+\dot{y}\dot{y}\dot{x}^2-\dot{z}\ddot{x}^2}$; an expression which, it is manifest, may be simplified by supposing either x or y constant. From the whole he infers, that the entry of second fluxions into the definitive expression does not imply, that the *nature* of the problem necessarily requires it: but that it arises from the particular artifice which is employed in finding the value of v, the ordinate of the equicurve circle.

Observations.—There is an inaccuracy in Mr. Moore's resulting expression for the radius of curvature, in consequence of his making $\frac{v\dot{x}\ddot{z}}{\dot{x}^3}=0$, instead of $\frac{v\dot{x}\ddot{z}}{\dot{x}^2}=0$. The simplest general expression for the radius of curvature is $\frac{\dot{x}^3}{\dot{y}\ddot{x}-\dot{x}\ddot{y}}$; which, as is well known, becomes $\frac{\dot{x}^3}{-\dot{x}\ddot{y}}$ or $\frac{\dot{x}^3}{\dot{y}\ddot{x}}$ according as $\dot{x}$ or $\dot{y}$ is supposed to be constant.

But, independent of this error, we are by no means persuaded of the utility of the inquiry, as we can see no advantages likely to result from it. Any person moderately versed in the fluxionary calculus, will readily find that second fluxions are necessary even to express the radius of the simplest of all curves, *a circle*, in terms of the rectangular co-ordinates of that curve. It is, in fact, the consequence of an expedient adopted for our convenience. The value of the radius of curvature where terms of the arc are retained in that value would be simple enough in appearance, and free from second fluxions; yet that simplicity would be *only apparent*, because in many inquiries the rectification of the curve is not accomplished; whence it becomes necessary, or at least highly advantageous, to express the radius of curvature in terms of the absciss and ordinate; and second fluxions are a necessary consequence of this mode of eliminating the terms of the arc. Indeed there appears to us an ambiguity in the manner in which Mr. M. has stated his inquiry. What, in precise terms, is the nature of the problem he would predicate? Is it the finding the radius of curvature? that is a point, which, as it relates to the conic sections and some other curves, may be determined by a method purely geometrical; and in this sense second fluxions are certainly unnecessary. Is it to find the radius of curvature through the medium

of the fluxional analysis? In that case, as we have already remarked, the radius of curvature will be expressed in first or second fluxions according as the fluxion of the arc is retained in that expression, or exterminated from it. So that, upon the whole, we look upon this paper as a work of supererogation; and we could wish to see its author direct his ingenuity to a more profitable topic.

Account of a new-discovered Fact in Hydrostatics, and of an Application of it. By Mr. JOHN WHITLEY BOSWELL.—*Repertory of Arts, No. 79, Second Series.*

THIS *new-discovered fact* consists in this;—that if a tube, with its lower aperture closed, be vertically immersed for a considerable part of its length in a vessel of water or other fluid, and the liquid be permitted suddenly to enter its lower extremity, it will rise in the tube above the general level of the water contained in the vessel. And with respect to this event, Mr. B. observes, "I imagine there is a ratio of increase of the height to which water will rise in this manner to the increase of the depth of the tube; the experiments I have hitherto made, at least, indicate this. In a tube $2\frac{1}{2}$ inches long, immersed one inch and a half, the water rose $\frac{3}{4}$ of an inch above the level; in a tube $5\frac{1}{2}$ inches long, immersed $3\frac{1}{2}$ inches, the water rose 2 inches; and in a tube $21\frac{1}{2}$ inches long, the water rose $7\frac{1}{2}$ inches above the level of that in the cask, in which it was immersed 14 inches deep."

Mr. B. supposes that this hydrostatical fact may be well applied to determine the slope at the hinder part of a ship, technically called its *run*, so that the water rising from the bottom of the ship's track may meet with the least possible impediment from the lateral resistance of the water pressing in from its sides.

Observations.—This hydrodynamical circumstance, which is here erroneously denominated a new-discovered fact in hydrostatics, is of so simple and obvious a nature as readily to present itself to every one who in any degree reflects upon the nature of matter, and the laws of moving bodies; and we cannot for a moment doubt but it had entered into the minds of hundreds before it astonished that of Mr. Boswell; the maximum height which the fluid will attain in the tube, is a proper matter of mathematical inquiry. In truth, he would have found it only a slight modification of the general theorem investigated by Sir I. Newton, at Proposition XLIV. book III. of the Principia, and more recently by Dr. Hutton, at page 206 of his Select Exercises; where the alternate rising and falling of the water in the tube is considered as strictly analogous to the isochronal vibrations of a pendulum; and as these oscillations are never supposed to militate against the general law of nature, or that the centre of gravity of the pendulum, abstracting all external resistance, will not finally rest in the

lowest point of the arc, neither can it be supposed but that the fluid will ultimately maintain its general level, and arrive at a state of quiescence.

All that is affirmed by elementary writers on hydrostatics is, that when a fluid system generally connected by pipes and tubes, is in a state of equilibrium, the surface of the fluid in any of the vessels (thus connected) which contains it, is universally at the same distance from the centre of the earth, or, in other words, at *the same level*, if the whole fluid matter be of one and the same density. But when the equilibrium to the system is disturbed, it is another fact, not contradictory of the former, nor *newly discovered* (for it is hinted by Archimedes, in his Treatise *De Insidentibus humido)*, that, when the previously existing equilibrium is disturbed by any extraneous force, an undulatory motion will ensue, in which the different parts of the surface will be sometimes above, sometimes below the general level, and that the undulation will continually diminish until at length friction and other causes restore the equilibrium. Now what is done in Mr. Boswell's experiment but disturbing the equilibrium, by removing the plug, valve, or obstruction, from the bottom of the tube? and what can possibly be expected but that the fluid thus admitted into the tube should be propelled by the fluid behind it, and by the momentum acquired, to pass beyond the general level?

Account of Mr. F. C. DANIEL'*s Life-preserver, or Apparatus to secure Persons from sinking in Water, when shipwrecked.* —Transac. Soc. Arts, Vol. 25.

MR. Daniel's *life-preserver* has its body made of pliable water-proof leather, and double throughout: it is large enough to admit its encircling the body of the wearer, whose head is to pass between two fixed straps which rest upon his shoulders: the arms of the wearer pass through the spaces on the outside of the straps; one on each side, admitting the machine under them to encircle the body like a large hollow belt. There is a strap on the lower part of the machine, attached to the back of it, which is to be passed between the thighs of the wearer, and buckled before; so as to hold the machine sufficiently firm to his body, without too much pressure under the arms. The machine, being thus fixed, is inflated with air from the lungs, by the application of the mouth to a stop-cock attached to a flexible tube: when the whole is sufficiently filled, the turning of the cock retains the air in the machine—which is made capacious enough to hold such a quantity of air as will render buoyant upon water *four* persons suspended by the machine.

Mr. Daniel recommends his life-preservers to be prepared as follows; viz. To select sound German horse-hides, and to cut

a piece 6 feet long, and 2 feet 6 inches wide, free from blemish or shell; it is first to be curried, and then rendered water-proof by Mollerstein's patent varnish, which keeps the leather supple. The leather is nailed on a board, and the varnish applied upon it: it is then to be passed into an oven several times, the varnish being each time repeated till the leather is completely covered; then it is cut in the form of a jacket or waistcoat, and firmly stitched, the seams being afterwards perfectly secured by the following black elastic varnish:

℞. Gum asphaltum, 2 pounds; amber, half a pound; gum benzoin, 6 ounces; linseed oil, 2lbs.; spirits of turpentine, 8lbs. and lamp-black, ½ a pound; united together in an earthen vessel with a gentle heat.

Mr. Daniel's description is accompanied by testimonials from different persons proving the great utility of the life-preserver. One of these is from John Dickenson, Esq. of Norwich, who, being out upon a sailing-party, with two ladies and a gentleman, at the extremity of a broad water, two miles across (near Norwich), known by the name of Braydon, a sudden gust overset the boat, precipitating all four into as agitated a water as is ever seen at sea, except in very hard-blowing weather. The life-preserver had been filled jokingly as they sailed along; but was found extremely useful in this dangerous juncture. Mr. Dickenson first reached his male companion, who was inexpert at swimming, and directed him to lay hold of the collar of his coat, over which the machine was fixed: he then proceeded towards the ladies, whose clothes kept them buoyant, but who were in a state of fainting when he reached them: then taking one of the ladies under each arm, with the gentleman hanging from the collar of his coat, the violence of the wind drifted them all safely on shore.

Observations.—It is in the rewarding and introducing to public notice such beneficial inventions as those of Mr. Shipley, Mr. Bell, &c. noticed in our present volume, that one grand and distinguishing advantage of an institution like the Society of Arts and Manufactures, is rendered most striking and obvious. But that this advantage may not be converted into a source of evil, and may not furnish ignorant boasting pretenders with an opportunity of triumphing over indigent, unassuming merit, by adopting its discoveries, and then suffering it to languish and pine in obscurity, unassisted and unhonoured, it is necessary that rewards should be dispensed to *real* inventors, and *original* promulgators of useful discoveries. This is certainly not the case on the present occasion; as will be manifest to any of our readers who will turn to our account (in the following page) of the patent taken out in the year 1764, by Mr. W. Cobb, for an air-jacket. We are neither prepared nor *inclined* to say that Mr. Daniel derived the hint of his contrivance from the previous patent of Mr. Cobb, because it is quite within the bounds of probability, that the

latter invention might be made totally independent of all acquaintance with the former; but we are both prepared and *inclined* to say that the proper committee of the Society of Arts ought to have known of Mr. Cobb's contrivance, as well as of similar contrivances described in *Leopold's Theatrum Machinarum* (contained in their own library); and therefore *ought not* to have rewarded that of Mr. Daniel. The several committees of the Society of Arts should consider themselves as trustees answerable for the proper management and disposal of the money advanced by the subscribers, not for the purposes of any *job*, or to advance the schemes of any *junto*, but for the reward of merit and the encouragement of the arts and sciences. The business of the Society is distributed through the committees superintending the various departments, in order that persons most celebrated for their acquaintance with any one of the respective subjects that come before the Society, should be elected into their appropriate committee. And if the members of any such committees are ignorant of the history of the progressive improvement of the theory, or of the practice of the department referred to them in particular, we see no difference, as to the real use of the Society, between filling its committees in that way, and filling them with *any* ten or twelve men that could be laid hold of in Cheapside or Cornhill, about the time of full 'Change. We wish well to this Society, because we believe it has been useful, and because we are convinced that, under proper management, it may be rendered still more so: but we cannot help feeling regret and vexation, whenever we see its funds misapplied by rewarding trifling inventions or old inventions revived, with those sums which ought to serve as a stimulus and a reward for real ingenuity.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, DURING THE MONTHS OF OCTOBER, NOVEMBER, AND DECEMBER, 1808.

Mr. WILLIAM COBB*'s Patent for a Method of making an Air-jacket, and proper Shoes for Swimming, to prevent the fatal Consequences attending Sailors and others in Shipwreck. Dated March* 1764. *Term expired.—Repertory of Arts, No. 77, N. S.*

THE jackets proposed by Mr. Cobb are made of any pliable leather, or other substance capable of holding air: they are cut in the form of a short jacket without sleeves, with pieces sewed on the outsides and back bigger than the insides, to hang loose and hollow, so as to contain, when necessary, a sufficient quantity of air. This air may be blowed through a bag or receptacle having a pipe fixed to it for the conveyance of air into the recep-

tacle, and thence between the loose jacket and lining, by proper communications from one part to the other. Each jacket is made to button before; the button-holes round the skirts to be fastened to the waistband of the breeches.

The shoes are made with pieces of wood cut in the form of a shoe-sole, and hinges screwed to the wood with joints covered with leather: these are fastened to common shoes, that they may open and shut in swimming, to imitate the motion of a swan's foot in that exercise.

Observations.—See our remarks on Mr. Daniel's invention, described at page 399.

Mr. John Curr*'s Patent for a certain Invention of spinning Hemp for the Making of Ropes or Cordage. Dated March* 1806.—*Repertory of Arts, No. 77, N. S.*

The object of the invention described in the specification of this patent is to obtain yarn which shall contain an equal number of twists in equal lengths; and to regulate the number of twists according to the length of the yarn, and the purpose to which it is to be applied. For this purpose Mr. Curr fixes a small drum on the axis of the wheel commonly used for spinning hemp. A small cord or other fit material, at least as long as the thread intended to be spun, is coiled about the drum, so that it may be unwound by the motion of the wheel; the loose end of it is fastened to one of the spinners, all of whom recede from the wheel as fast as the cord is uncoiled, preserving a straight line with each other; and their speed is necessarily regulated by the motion of the wheel, being quickened or retarded as the wheel is turned quicker or slower. The diameter of the drum for forming yarn of a common twist is about twelve inches; but it must be increased or diminished according as the yarn is required to be less or more twisted. All the whirls that are used at the same time should be of an equal size; and the spinners begin and end their threads together; by which means all the threads will have the same twist, and stretch nearly alike during the using, as well as the laying of the rope which is composed of them.

Observations.—Those who are conversant with the manufacture of ropes, we are persuaded, will not be inclined to deny Mr. Curr the credit of an improvement in forming the threads of which they are composed with an equal degree of twist; as it undoubtedly brings the fibres, of which a rope is formed, into a state of combination, in which each is fitted for bearing its due proportion of any tension exercised upon the whole. It is evident

that the degree of twist depends on the rate of the wheel's motion, combined with the retrograde walk of the spinner; and it is the attainment of a more perfect combination of these two motions that constitutes the object of Mr. Curr's simple invention, in the application of a minor wheel and regulating cord.

Mr. JOHN CURR'S *Patent for a Method of applying flat Ropes, flat Bands, or Belts of any Kind, to Capstans and Windlasses of Ships and Vessels; and also for a Method of applying flat or round Ropes, Lines, Bands, or Belts, for the Purpose of catching and detaining Whales. Dated July* 1808.—*Repertory of Arts, No. 79, N. S.*

THE method of applying a flat rope to the purpose of towing vessels, is by attaching it to the capstan, so that it can easily be taken off and coiled upon itself, or wound about a capstan in one or two tiers, as required; in the same manner as a flat cable is wound upon a windlass, described in Mr. Curr's patent, dated in July 1806. If the flat rope be wound in one tier only, it will be necessary to fix on the capstan axletree a large-tooth wheel, in order to give the sailors greater power, and which may be worked by a small-nut wheel, or wheels of convenient dimensions. Two flat ropes, &c. may also be applied to the same capstan by adding, to the above-mentioned wheel, another moveable wheel, having a circular centre, and which may be turned without causing either the axletree or drum of the capstan to revolve.

These ropes may be worked separately, and each will require a roller or rollers to guide it from the stem or stern of the ship in a fair direction to the capstan. A third rope and wheel may be added if necessary; and the advantages of towing vessels by this method consist in saving labour, in expedition, and in preventing the deck from being so much encumbered with ropes.

The method of applying flat or round ropes, for the purpose of detaining whales, described in the second part of this specification, relates to the invention and manner of fixing a reel and brake in a whale-boat. The reel about which the rope is wound is fixed across the boat, toward the stern, whence the rope is conducted, by means of rollers, to the head of the boat, where it is regulated by a stop or guide, by which the rope is retained, when nearly run out, until its end is fixed to another. The brake is fixed to one end of the reel, and by pressing down a lever its force upon the reel resists in some degree the action of the whale.

The advantages to be derived from using this apparatus in catching whales, as enumerated by the patentee, are, 1st, the lines are not subject to be entangled as in the old way; 2dly, the lines are not liable to injury as when running round the bollard; 3dly, the men's hands are frequently inflamed by holding back the line, which is avoided by this method, as the speed of the whale may

be effectually retarded, without either danger or difficulty, by means of the brake; 4thly, the line being confined in the stern and middle of the boat, prevents the danger and inconvenience of having it at liberty; and 5thly, by making a boat large enough to contain two reels, and a sufficient quantity of line, fewer boats and a smaller number of men will be required to man a ship.

Observations.—When we consider the danger and hardship to which those are exposed who are engaged in the whale-fishery, we cannot but readily welcome any invention or improvement that has a tendency either to lessen the one or ameliorate the other. And as we doubt not but Mr. Curr's manner of regulating the line, during the time of its running off, will obviate several of the disadvantages attendant on the old method, we do not hesitate to recommend it to the attention of those who are fitting out ships for this purpose.

Mr. John Hall's *Patent for certain Improvements in making and manufacturing Ropes and other Cordage, and coiling of Lines in Whale-boats. Dated June* 1808.—*Repertory of Arts, No. 77, Second Series.*

Mr. Hall's method of forming ropes or cordage, described in the former part of this specification, is so similar to that in the former of Mr. Curr's patents just described, that the same account is equally applicable to both, with this exception, that in the present instance, instead of the regulating cord, which is coiled round the drum or minor wheel, being fixed to one of the spinners, it is passed over a pulley or another wheel at the bottom of the rope-walk, and returned again to the first wheel, having its ends fastened together, and forming an endless band: the speed of the spinners is regulated by a conspicuous mark attached to the cord, with which they are to keep pace. In making warp-laid ropes, Mr. Hall claims the invention of a wheel containing nine spindles, by which the whole number of strands is made at once.

The other part of Mr. Hall's specification, which relates to the method of coiling lines in a whale-boat, is also similar to Mr. Curr's method, described in the preceding article; but wanting the regulating rollers in the middle of the boat, the stop or guide at its head, and the brake-lever.

Observations.—We have already pointed out an instance in which a former patent of Mr. Curr's was followed, in all the essential particulars, by a subsequent patentee (see page 47 of our present volume, or Repertory of Arts, vol. x. p. 361, of the First Series): and from the similarity of Mr. Hall's patent, and the two pre-

ceding ones granted to Mr. Curr, there can be no doubt but the inventions claimed by each have originated in the same source: and from tracing the improvement in Mr. Curr's mind, independent of all *other* considerations, it would seem most natural to ascribe the *original* thought to him.

Mr. JOHN HARRIOTT's *Patent for a new Fire-escape, or Machinery to be used in Cases of Fire. Dated May* 1808.—*Repertory of Arts, No. 77, Second Series.*

THIS specification sets forth three separate machines for this purpose; the first, or chamber fire-escape, consists of a fastening made of wood or metal, in the nature of a crane or hinge, to fix to the bottom, top, or sides, of any window or other opening in a house or building. Towards the projecting end of this fastening there are two holes, through which a rope, having a noose at one end, is to be passed. The length of the rope ought to be such as at least to reach the ground when double: the person to be rescued puts the noose over his head and shoulders, and the other end of the rope being thrown to some person on the outside, or held by any person remaining in the room, he may be let down to the ground in safety.

The external fire-escape, or machine for moving from house to house, is upon the same principle as this already described, but fixed to a pole of a proper length, and furnished with the means of laying hold of any window-cill, &c. to which it is elevated.

The third is also an external fire-escape, formed upon the principle of the idler, lazy-back, or lazy-tongs, and consists of a number of straight bars, of either wood or metal, of the same length, bolted together in pairs in the centre of each bar. Each pair is connected with that adjoining it by means of bolts passing through the ends of each bar, on which, as well as the centre-bolts, they are permitted to work freely; both the number and length of the bars being regulated by the height to which the machine is to be raised. Two or more sets of these connected bars are to be secured, at any required distance from each other, by means of bolts of that length; so as to form one piece of machinery. The four bottom ends of those bars are fixed on the bottom of a case, to which four wheels are adapted, that it may be readily moved to the place wanted; to the four upper ends of the bars, a canvas or slight platform is fastened, which is to be raised to the place whence people or goods are to be rescued. The whole is elevated with great celerity by a force applied to the lowest pair of centre bolts, by means of a common timber jack, a rope and roller, worked by a tooth and pinion wheel with a winch handle, or in any other similar manner.

Observations.—With respect to the general mode of descent by means of a rope there certainly is nothing new, and the particular method now proposed, in the first two of Mr. Harriott's fire-escapes, is liable to several objections; one of which is, that it requires the assistance of a second person either from within or without, while it is obvious that cases may happen where it is not possible for this to be obtained. But even admitting that a person was not alone in a room, the consternation occasioned by the alarm, that renders the use of this apparatus necessary, would certainly, in a very great degree, prevent such person from receiving that assistance by which alone safety can be ensured. The first of these, however, is simpler than that invented by Mr. Maseres, and described at page 64 of our vol. iii. The last of Mr. Harriott's external fire-escapes we conceive does not possess any advantage over several others that have been invented for a similar purpose; an account of which may be seen in the Repertory of Arts, vol. i. page 439, Second Series. We must, therefore, still consider a complete internal fire-escape as a very desirable object, and we apprehend it ought to possess the four following qualities: 1st, a sufficient degree of portability to be kept in a bed-room without inconvenience, and managed by one person; 2dly, the property of not having its component parts easily disarranged or put out of order; 3dly, the property of a speedy *self-adjustment* when used; and 4thly, it should form an easy and safe conveyance from the window where it is fixed to the ground.

The model of a fire-escape, precisely the same in principle, and very nearly the same in all its particulars, as that described by Mr. Harriott as his third machine for an external fire-escape, has been exhibited by the ingenious Mr. Hawkins, in his Museum of useful and mechanical Inventions, No. 79, Titchfield Street, we believe some time previous to the date of this patent; and in our opinion, those parts in which Mr. Hawkins's machine differs from Mr. Harriott's, render the former gentleman's invention superior to Mr. Harriott's.

Mr. Edward Coleman*'s Patent for certain Improvements in the Construction and Application of a Horseshoe, which will completely prevent several Diseases to which the Feet of Horses are subject, more especially that very general Disease called Contraction of the Hoof; and is also particularly adapted for flat or convex Feet, for Horses of the Cavalry and Hunting, and for all other Purposes where the Loss of a Shoe is productive of great Inconvenience. Dated April* 1808.—*Repertory of Arts, No. 77, Second Series.*

The difference between this shoe and others consists merely in the inner and posterior part of both heels, which in this are turned

up so as to touch the inner and posterior part of both bars, by which the heels of the hoofs are prevented from contracting, and the shoe from having the least lateral motion. The length of the part turned up should be such as to embrace the heel of the bar, but not to touch the bottom of the cavity between the bar and the frog. A bar-shoe may likewise be applied to press against the heels of the bars, by means of a similar projection.

Observations.—It may be necessary to inform some readers, that by the word *bar*, as used in the specification of this patent, is meant a continuation of the fibres of the horse's heels, which turn towards each other, advance to the extremity of the frog, and there form an acute angle, and acting by mutual resistance from within, outwardly oppose the contraction of the heels. The *frog* is that external convex part placed at the sole of a horse's foot, and of a wedgelike form, pointed towards the toe: and we believe that it is now regarded as a law of nature, that unless the frog perform its functions, by sustaining a due degree of pressure, it will become diseased. In order, therefore, to cause the frog to expand, by suffering it to be in contact with the ground, Mr. Coleman, on a former occasion, recommended a shoe with *thin heels*, as the best means of preventing those diseases by which the feet of horses are so frequently affected: his present invention appears to be an improved method of resisting the contraction of the hoof, by causing a pressure to be exerted on the bars as well as on the frog.

Mr. William Lester's *Patent for an improved rotatory Motion or Engine to communicate Power to Machines. Dated June* 1806.—*Repertory of Arts, No.* 78, *Second Series.*

The wheel-work of this engine is supported by a horizontal beam of wood, which rests upon two upright posts or supports, of sufficient height and distance from each other to permit the levers, to which the horses or oxen are yoked, to turn between them and beneath the horizontal beam. On one side of this horizontal beam is fixed a strong cast-iron chair, which supports the upper end of the vertical axis to which the horse-levers are attached; the lower extremity of this axis turning in a kind of socket fixed on the top of an upright support for that purpose. To the upper end of this axis, above the horizontal beam, a large-tooth wheel is fixed, which works a pinion on another upright axis supported by the iron chair; and which also contains a horizontal beveled wheel, which turns a second pinion, and changes the motion from horizontal to vertical. The axis of this last pinion is parallel to the supporting horizontal beam, and rests with one end

upon the iron chair, and the other upon a support fixed upon one of the upright posts which bear the beam. The cluch end of this horizontal axis, without this last support, contains a horned wheel, over which a rope or chain passes, and is connected with another wheel belonging to the machine, to which the power is communicated.

This description answers to a fixed engine; such as are portable are supported by means of two tripods instead of the upright beams, and possess some modifications of the different parts, but work upon the same principle: and in both, the horses, which communicate the power, are prevented from receiving any injury by stopping suddenly when yoked to a machine in rapid motion, by means of a screw attached to the axle of the levers.

Observations.—We can find nothing in this combination of wheels, pinions, horn-wheels, and bands, which entitles it to the character of an invention; nor can we conceive what could induce Mr. Lester to attempt securing to himself by patent the exclusive right of using such a combination.

Messrs. Joseph Willmore's *and* John Tonk's *Patent for a new Method and Process in the manufacturing of Nails. Dated May* 1808.—*Repertory of Arts, No.* 78, *Second Series.*

The first operation set forth in this specification is to apply a nail-rod to a common screw-press, mounted with proper cutters, and to cut off, from one end of it, two pieces at once, obliquely across the rod in one place, and directly across it in the other: the size of the rod and the obliquity of the cut being regulated by the kind of nail that is to be made. Each piece, after being properly annealed, is then put into a pair of clams, leaving as much of the thick end projecting as is sufficient to form the head of the nail. When the punch is brought down upon the piece with considerable force, the sharp edges of the clams raise up part of the iron on each side for the purpose of forming the head. The piece is afterwards put into another pair of clams, or the tool generally called a bore, and then pressed with a punch in which is engraved or sunk an impression of the head required to be formed. The nails are then pointed by putting each into a bed of steel, shaped according to the intended point, and applying a strong pressure.

In order to obtain a sufficient degree of pressure with more convenience than by the common mode, these patentees have fixed a pulley to the head of the main screw, whence a rope or chain passes over another vertical wheel or pulley attached to the frame of the press, and is connected with the moveable end of

the treadle, which is loaded with a weight heavy enough to press the clams or die which contains the nail with the requisite force; and thus the operation of pressing is effected by the hand only.

Observations.—We are at a loss to perceive in what way these patentees intend to obtain either facility or superiority of execution by the method of manufacturing nails particularized in the specification of this patent, over those modes of making them, for which patents had been previously obtained. For accounts of these methods, we refer our readers to vol. vii. page 217 and 377, of the First Series of the Repertory of Arts; to vol. ix. page 390, of ditto; and to vol. vi. page 16, of the same work, Second Series.

Mr. JOHN STEDMAN*'s Patent for a Patten and Clog, being of infinite Utility and Ease to such Persons as may wear them. Dated May* 1808.—*Repert. of Arts, No.* 78, *Second Series.*

THE bottom or sole of this patten or clog consists of two or three parts or pieces, connected together by means of one or two hinges. To the under side of each hinge there is a spring prefixed which acts upwards; or when the sole of the clog is formed of three parts, they may be joined together without the hinges, by a flat spring either nailed or screwed to the upper side. A piece of leather or other suitable substance is fixed to the hind part of the patten or clog to embrace the heel, and is to be made to fit the shoe with which it is intended to be worn. The bottoms may be made of any kind of wood; but Mr. Stedman claims the exclusive right of using cork for this purpose, as being a new substance used in this manufacture, either with or without his new-invented principle.

The patentee observes that the intent of this invention is to prevent the clog from coming off the foot; to remove the usually unpleasant clacking noise; to hinder it from throwing up dirt; and to lessen the fatigue of walking, occasioned by pattens and clogs made in the common manner.

Observations.—Mr. Stedman's ideas of the advantages that will result from his invention, are either extended far beyond what will ever be realized, or his notions relative to the meaning of the term by which he has specified them, in the title to his patent, are amazingly contracted; otherwise how can the expression "of infinite utility and ease," be reconciled with the reality, unless he be allowed the *well-deserved* merit of having used it *hyperbolically?* Experience, we are inclined to believe, will prove that the necessary expense of these pattens or clogs, their complicated nature, and the liability of their several parts to

be disarranged, or put out of order, will be a powerful counteraction to their general adoption. And with respect to the patentee's use of cork instead of common wood, whatever he may gain in convenience through the lightness of the material, will be counterbalanced by its additional expense and want of durability.

Mr. William Congreve's *Patent for a new Principle of measuring Time, and constructing Clocks and Chronometers. Dated August* 1808.—*Repertory of Arts, No. 79, Second Series.*

The mode of measuring time and constructing clocks and chronometers, which constitutes the basis and specific character of this patent, consists in detaching the time-measurer from the first mover for a greater extent of duration than had before been effected. In the present construction of time-pieces, by means of the pendulum and balance-wheel, this detachment does not exceed one second, as the moving or maintaining power imparts a fresh impulse to the regulating power at each oscillation; and it has been supposed that, if this detachment could be extended to a much longer period, the regulating power would be more under the uniform influence of gravity, and a more accurate measure of time would be the result. But the increase in the length of pendulums bears so high a ratio to the decrease in the number of their vibrations, that to extend this detachment much beyond a second, by this means, was found to be impracticable; as to obtain a detachment of two seconds would require the length of a pendulum to exceed 13 feet, and one of three seconds above 29 feet: therefore, in order to remove this disadvantage in the present construction of clocks and chronometers, Mr. Congreve proposes to extend the period of detachment for the space of a minute or longer if thought necessary, and describes two distinct modes of effecting it. The first of these modes depends upon the proportionate space descended by a heavy spherical body when rolling freely down a plane of a given inclination, in any assignable period of time; and the second is a contrivance for increasing the detachment of the common pendulum or balance-wheel, without either increasing the length of the one, or the diameter of the other.

Of the former of these modes he makes different applications, and procures different periods of detachment. First, a small straight tube, six inches long, containing a steel ball, is connected with the train of an eight-days clock by an arbor and pinion; and this tube being a little inclined, the ball descends from the upper to the lower extremity, where its momentum disengages a small spring detent which had kept the tube in its position; the tube being thus set at liberty, is caused to revolve half round by

the train; its other extremity, therefore, descends to the detent and is fixed by it. The ball being thus brought again to the upper end of the tube, makes a second descent, and discharges the spring of the detent as before, and so on in continued succession. The inclination of the tube is such as to cause the ball to descend forty times in a minute, and to serve the purpose of a common pendulum of 7 feet 4.038 inches in length: each of these forty portions of a minute being compounded of the two durations occupied by the descent of the ball and the half revolution of the tube, and the latter being only one third of the whole, the train of the clock will consequently be at rest two thirds of the whole time. The descent of the ball along the tube is regulated by a small hand which elevates or depresses the detent, and therefore varies the inclination of the plane, and with it the time of the ball's descent.

In Mr. Congreve's second application of this principle, instead of one small tube he makes use of a series of five tubes attached to the surface of a vertical wheel connected with the train as before. The tubes are equally inclined to the horizon, but are placed in an alternately reversed order, and are so connected together as to permit the ball to pass from one extremity of their united length to the other. The wheel is likewise kept in a given position by a spring detent at the lower extremity of the series of tubes, and which is discharged, as in the first case, by an impulse from the ball at the termination of its descent: the wheel is then caused to revolve half round, the other end of the tubes is fixed by the detent, and the ball commences a fresh descent. In this case each descent of the ball and the motion of the wheel together occupy six seconds; and as this latter motion is performed in half a second, the first mover and the train are at rest, or the regulating power is detached from the first mover, for eleven twelfths of the whole time; a state of rest equal to what would be obtained by a common pendulum of 116 feet 8.608 inches in length.

Mr. C. then shews how this detachment may be carried to a still greater extent of time by means of an inclined plane, fourteen inches long, and eight inches broad, having thirty grooves cut in its upper side, from edge to edge, joined together at each extremity, and making equal angles with each other. This plane is nicely balanced on a sharp-edged suspension, so that a small force will change the direction of its inclination; which is effected through its connexion with the train by means of a crank and rod, or some similar contrivance. The degree of the plane's inclination is so regulated, that the ball descends successively through all the grooves, and the direction of the plane is reversed, after being set free by the impetus of the ball, as in the two preceding methods, in the exact period of a minute. The acceleration which the ball acquires in its descent down each groove is destroyed by

brass deflectors, placed at the angles where their extremities are connected together, and its direction is changed from one groove to another. The ball is not allowed to remain in a quiescent state during the motion of the plane in changing its direction, but on discharging the spring detent at the end of its course, it is immediately thrown back with the mean velocity of its motion, by the action of a small crooked arm or spring, so that no inequality in the motion of the ball is produced by the first mover during the changing of the plane; when the ball has arrived at the opposite extremity of the series of grooves, the spring of the detent is again discharged, and the position of the plane changed as before, and so on in regular succession as long as the moving power retains its force: as this change of the plane's direction is effected in less than half a second, the moving power, as well as the whole train, is in a state of repose more than one hundred and nineteen one hundred and twentieths of the whole time. By this means the detachment is extended to as great a duration as could be obtained by a simple pendulum of 11,735 feet 4.8 inches long; and thus a common eight-days clock, Mr. Congreve asserts, may be made to continue going for 480 days without any increase of either weight or works. The smallest portion of the intermediate time may also be indicated in this method with the utmost precision. For this purpose a bridge or bridges are placed across the plane, under the arches of which the ball passes; and the figures above, that indicate these divisions, are made to change their positions according as the ball runs from right to left or from left to right, so that they may always be read the same way the ball moves.

The patentee then gives a further application of his theory by means of three equal and straight tubes, connected together in the form of an equilateral triangle, attached to a vertical wheel, and containing two balls; this wheel is fixed to the train, and regulated nearly as in the preceding cases.

He then proceeds to specify the method of obtaining a similar detachment by means of the common seconds pendulum or balance-wheel in general use, and which constitutes the second part of his specification. To effect this purpose, two pallets are connected with the pendulum, and by the motion communicated to them by its oscillations they are made to drive or turn a light vertical wheel containing thirty teeth; one side of this wheel contains a pin that unlocks a detent at each revolution, and gives liberty to another swing wheel of sixty teeth connected with the train; this last wheel is immediately impelled forward to impart a fresh impulse to a third pallet fixed to the pendulum, in order to restore the oscillating power it had lost in the fifty-nine preceding free vibrations. The first of these wheels makes one revolution in a minute, and as the other is released for one second in each of these revolutions, and caused to move one tooth forward at each release, it completes one revolution in the space of an hour; having

been at rest fifty-nine minutes of it. Each of those wheels may be furnished with a hand to point out these usual divisions of time.

This mode of escapement, the patentee observes, may evidently be applied to balance-wheels of watches and chronometers, though with some limitation in respect to the duration of detachment, which he supposes cannot conveniently be so far extended in these as in clocks; since the same independent power of vibration cannot be imparted to the balance-wheel by the spring, as to the pendulum by the force of gravity.

Among the general advantages that Mr. C. affirms will result from his new principle, which he denominates the mode of *extreme detachment*, the following are enumerated: First, a diminution in the moving power; as, upon this principle, it will not have more to perform every minute, than in the common mode it has every second; the friction of applying this power in the former, being only one sixtieth of what it is in the latter way. 2dly, An increase in the time of going, for with the same power this is extended to sixty times as long as in a clock of the common construction. 3dly, A reduction in the wear of the works; arising from their long state of repose. And 4thly, a simplification of the train; for an eight-days clock requires only one pinion with the ordinary numbers, and a year clock may be made with only two pinions and the ordinary numbers of an eight-days clock, and with very little more power.

Observations.— Mr. Congreve's description of his new principle for measuring time contained in this specification, certainly exhibits a degree of ingenuity and novelty which we do not frequently meet with on similar occasions, but it also manifests a boldness of assertion and a degree of solicitude in guarding against all unlawful infringements upon his patent-right, that are equally uncommon. We, however, whom time and habit have enabled to consider the subject with a little more coolness than the patentee appears to have done, may venture to remove some of his apprehensions on this latter point, by assuring him that his patent is not in so much danger of being invaded as he seems to suppose. We shall likewise add a few remarks on this new principle, not with a view of blighting the fruits of Mr. C.'s ingenuity, but of stimulating it to fresh exertions, that, by removing some of the objections to which his plan is at present exposed, and lessening others, he may cause it to approximate towards that state of perfection, which his language induces us to suppose he believes it to have already attained.

It is generally admitted, by those who are best acquainted with the principles and construction of time-pieces, that the chief irregularities in the performance of pendulum clocks arise from the expansion and contraction of the pendulum by means of heat and

cold, the want of sufficient firmness in its support, and the variations in the state of the atmosphere: and the second of these exerts a much greater influence in this respect than is commonly supposed; as when a good compensation pendulum was suspended from a firm support, and supplied with maintaining power by a common wooden Dutch clock, the performance was nearly equal to that of an excellent regulator. This disadvantage attends each of Mr. Congreve's methods of applying his new principle: and with respect to the third source of irregularity, it is greatly increased in them all. The bob of a common seconds pendulum generally possesses considerable weight, and is of that form best calculated to meet with the least possible resistance from the air in its vibrations, in each of which, at a medium, it passes through a space of about five inches. In Mr. Congreve's six-inch tube, the sum of the spaces passed over by its two centres of percussion in every half revolution, is nearly thirteen inches; and as the time of motion does not exceed half a second, the velocity of each of these centres of percussion is about thirteen inches per second, while that of the centre of percussion of the common pendulum is only about five inches in the same period: hence, as the variation in the resistance of the air is in the compound ratio of its density and the square of the velocity of the moving body, it will manifestly be much greater in the case of the tube than in that of the simple pendulum; and this will be still further increased when the disadvantages, in point of both figure and weight, attending the former are taken into the account. And the nature of this remark is so obvious, that the reader will find no difficulty in referring it to Mr. Congreve's other modes of applying his new principle; particularly where the moving body presents a surface of 112 square inches, and the common pendulum is left to its full influence for 59 successive vibrations.

Other sources of irregularity, of which the patentee has not taken any notice, are the locking and unlocking of the spring detents, and the destruction of the momenta acquired by the tubes and plane in changing their positions. The motions by which these operations are effected, for want of attending to the difference of power exerted by the teeth of a wheel upon a pinion at the time of their beginning and ceasing to act, he erroneously supposes to be uniform; and the irregularity proceeding from this cause, we are inclined to think, he will find a very formidable obstacle to the application of his detached escapement to the construction of chronometers, as they are required to ascertain the smaller divisions of time with so great a degree of accuracy; but in which application the chief utility of his invention would consist, if this obstacle were completely overcome. Mr. Congreve, however, seems entirely to mistake the degree of detachment of all good escapements, where the sustaining force acts but for a very short portion of the whole time.

Brass deflectors are proposed to be inserted at each angle, where the grooves are joined together on the surface of the plane, in order to destroy the momentum acquired by the ball in descending down each groove, but, from the great elasticity of this metal, they certainly would not produce the desired effect. Neither can we grant this patentee the truth of his assertion, where he says, that, "in giving the one united impulse, there is no more friction than in giving each of the sixty lesser ones," unless he can convince us, that it requires no more power to restore the loss sustained in sixty free vibrations of a pendulum, than to restore that suffered in one of them. He also completely abandons the great principle of modern time-keepers, the isochronism of vibrations of different lengths, at least in his descending balls, where there is nothing to compensate for the inequality of force: a pendulum returns in the same time when urged, *in the middle of its vibration*, with a force of one grain, or of a hundred; in his machines, this advantage is lost: and many irregularities will likewise arise from the accidental friction of the tubes.

Whether or not Mr. Congreve will be able to bring his new principle to a much greater degree of accuracy than he has yet done, we shall not take upon ourselves to say; but an attentive consideration of the preceding remarks must convince every unprejudiced person, and ought to convince him, that it is at present far short of that state of perfection upon which its utility must inevitably depend.

CHEMISTRY AND MINERALOGY.

On the Decomposition of the Earths, the Metals obtained from the alkaline Earths, and on the Amalgam procured from Ammonia. By Mr. HUMPHRY DAVY.—*Phil. Trans. for* 1808, *Part II.*

THE imperfect trials made upon the earths, as stated in Mr. Davy's former paper (see p. 184), countenanced the ideas that had very early obtained respecting their metallic nature; but many difficulties occurred in obtaining complete evidence on this subject.

The earths are non-conductors of electricity, and the only methods of operating upon them by electricity were in some of their combinations, or of combining them at the moment of their decomposition, by electricity, into metallic alloys.

Barytes, strontites, and lime, slightly moistened, were electrified by iron wires under naphtha, as in the decomposition of the alkalies. An inflammable gas was evolved, and the earth in contact with the negative wire became dark-coloured, with small metallic points. These points became white by exposure to air or water,

in which last fluid a greenish powder separated from them, and a gas was disengaged.

No distinct metallic globules could be obtained by heating potassium in contact with dry lime, barytes, strontites, or magnesia, in tubes of plate-glass; but only dark brown substances which evolved gas from water. Mixtures of these earths with dry potash in excess, being melted and electrified, gave metallic substances, less fusible than potassium, which burnt the instant they were formed, and produced a mixture of potash and of the earth that was employed. Only minute films of these metals could be produced under naphtha, which were instantly destroyed by the contact of the air.

Two parts of barytes and one of oxide of silver, very slightly moistened, were electrified by iron wires; an effervescence took place at both points, and a silver-looking substance was formed at the negative wire. This coated wire, plunged into a solution of alum, evolved hydrogen, and let fall sulphate of barytes.

Barytes and red oxide of quicksilver being electrified, a solid amalgam adhered to the negative wire; that absorbed oxygen from the atmosphere, and reproduced barytes. It also decomposed water, and barytes was regenerated.

Mixtures of lime, strontites, or magnesia, with red oxide of quicksilver, treated in the same manner, yielded similar amalgams: but all these metallic substances were mere superficial formations on the points of the wire, nor did they increase after the first few minutes of electrization, even when the process was carried on for some hours; the batteries were, it must be owned, injured by constant use.

All the experiments mentioned in this paper may be repeated by a battery of 100 or 150 plates, of four or six inches: but the new apparatus made for pursuing this inquiry consisted of 500 pairs of double plates of six inches square. The heat generated by this apparatus, when platina wires of 1-40th inch diameter were employed, burned both the quicksilver and the new metals at the moment of their formation. When the surfaces of the conductors were extended, this power of ignition was modified, but still only films of the amalgam were produced. Iron wires of the same thickness became ignited, and alloys of a dark grey colour were obtained, which decomposed water, and were converted into oxide of iron, and the regenerated earths.

During these experiments, advice was received from Professor Berzelius, that he and Dr. Pontin had decomposed barytes and lime, by negatively electrifying quicksilver in contact with them, by which means amalgams were obtained.

A globule of quicksilver, electrified by the battery of 500 weakly charged, was made to act upon slightly moistened barytes, in a plate of platina; the quicksilver became less fluid, and an amalgam was obtained. A similar result took place with lime, and very rapidly with strontites; at first no amalgam could be

obtained from magnesia; but by continuing the process for a long time, and keeping the earth continually moist, a combination took place.

These amalgams may be preserved under naphtha for some time, but at length they become covered with a crust. In the open air, the crust is formed in a few minutes. The amalgam from barytes was most rapidly decomposed in water, hydrogen being evolved; and then those of strontites and lime: that from magnesia was very slowly changed, unless a little sulphuric acid was added to the water.

An amalgam could be much sooner obtained by using moistened sulphate of magnesia, than by using the moistened earth. Amalgams were, in like manner, attainable from muriate and sulphate of lime, muriate of strontites, or of barytes, and nitrate of barytes.

To procure these amalgams in quantity sufficient for distillation, the earths, slightly moistened, were mixed with one third of red oxide of quicksilver, the mixture placed on a plate of platina, and 50 or 60 grains of quicksilver were lodged in a cavity made in the mixture, which was covered with a film of naphtha, the platina being made positive, and the quicksilver negative. These amalgams were distilled with naphtha in tubes bent in the middle, whose extremities were enlarged so that one end served as a retort, and the other as a receiver. The naphtha was expelled during the distillation through an aperture in the receiver, which was hermetically sealed when the tube contained nothing but the vapour of the naphtha and the amalgam. The quicksilver rose pure, but was very difficult to separate entirely from the new metals, as nearly a red heat was required for the volatilization of the quicksilver, and at a red heat the bases of the earth acted upon the glass and became oxygenized. Fifty or sixty grains of amalgam required an apparatus whose capacity was about half a cubic inch; if it were larger, the naphtha furnished oxygen sufficient to recompose some portion of the earths.

The metal from barytes, or *barium*, as it may be called, is white like silver, it melts before ignition: ignited in plate-glass tubes, it produces a black mass which seemed to contain barytes, and a fixed alkaline basis in the first degree of oxygenizement: hence barium has a higher elective attraction for oxygen than sodium, so that the bases of the earths are probably more excellent media for detecting oxygen than the bases of the alkalies. The basis of barytes rapidly tarnished in the air, and regenerated barytes, in which process oxygen was absorbed, and nitrogen left unaltered. It decomposed water, evolving hydrogen. It sunk rapidly, even in sulphuric acid, although surrounded with bubbles of hydrogen: so that it cannot be less than four or five times as heavy as water. It required a considerable force to flatten.

The metal from strontites, or *strontium*, sunk in sulphuric acid, and also agreed in its other characters with that from barytes.

The metal from lime, or *calcium*, has the colour and lustre of silver, but it instantly took fire, and burnt with an intense white light into quick-lime.

The metal from magnesia might be called *magnium*, for magnesium would be equivocal, as having been already employed for manganese. This metal seemed to act on the glass before the whole of the quicksilver was distilled from it. The amalgam, containing only a little of the quicksilver, was white and solid, sinking rapidly in water, although surrounded with bubbles of hydrogen. In the air it became covered with a white crust, and fell into a fine powder, which was magnesia.

The amalgams acquired additional weight during the conversion of the metals into earths, but the proportion of oxygen could not be discovered: the earths were in their caustic or pure state.

Electrification of alumine or silex with quicksilver, or the common metals, was unsuccessful.

Alumine very slowly finds its point of rest in an electric circle at the negative pole; and silex, even when diffused in its gelatinous state through water, rests indifferently at either pole. If these bodies, therefore, are compounds, their electrical energies are nearly in equilibrium, and their state is either analogous to that of insoluble neutral salts, or to oxides nearly saturated with oxygen.

Silex was electrified in gold cones with water, connected by amianthus, as detailed in a former paper; the earth being placed in the positive cone: after some hours, the water containing the silex was found strongly acid, and that in the other cone strongly alkaline; on these fluids being mixed, silex was precipitated. But this acid was merely nitric acid that was formed in the experiment, and the alkali was merely an accidental ingredient in the silex; for when this earth was repeatedly electrified, it no longer afforded alkali. In this, as in other experiments with silex newly precipitated from liquor silicum, or fresh precipitated alumine, or the most carefully prepared boracic acid, the powers of electro-chemical analysis are continually demonstrating the imperfection of the common chemical methods.

Alumine and silex have a great attraction for potash and soda, and if oxygen be esteemed a common element to all, this attraction probably depends on their bases, and it was thought that it might assist in decompounding the former.

One part of silex, and six of potash, were kept melted in a platina crucible, and electrified positively by the battery of 500 plates. A negative platina wire being plunged into the mixture caused an effervescence; and globules burning with a brilliant flame rose to the surface. On removing this wire, brilliant metallic scales were found on the mixture when it was cooled, which

became covered in the air with a crust, and sometimes inflamed spontaneously. Similar experiments were made with potash and alumine with a similar result, but the metallic matter could not be detached; it instantly burnt when heated, and could not be fused under naphtha or oil.

Similar experiments were made with mixtures of soda and alumine, as also of soda and zircone, using iron for the negative metal; globules in a state of inflammation swam upon the melted mass, and when the mixture was cooled small laminæ of a lead colour, less fusible than sodium, adhered to the iron, which decomposed water, and produced soda and a white powder.

Alloys of potassium and the bases of the earths could not be obtained from mixtures of potash, silex, and alumine, fused by electricity, and treated in the same manner as potash when it was decomposed; for if the earths were in large proportion, the mixture could not conduct electricity; and in a small proportion the substance could not be distinguished from pure potassium.

Potassium was heated with silex and alumine in tubes of plate glass filled with the vapour of naphtha; a grayish opake mass, not possessed of metallic splendour, was obtained, which decomposed water, depositing white clouds; but this potassium might have been converted into a protoxide by the glass alone.

Potassium, amalgamated with one third of quicksilver, was electrified negatively under naphtha, in contact with moistened silex, for an hour. The potassium was oxidized by water, and the newformed alkali neutralized with acetous acid; when a white matter fell down, but its quantity did not allow its nature to be ascertained.

Alumine and glucine, treated in this manner, yielded a more distinct cloudiness; and zircone yielded a white powder soluble in sulphuric acid, and precipitable from that acid by ammonia.

Silex, alumine, zircone, and glucine, appear, therefore, to be metallic oxides; but the evidence is not perfectly satisfactory; for out of an immense number of experiments of the kind last detailed, only a very few gave distinct indications of the production of any earthy matter.

Professor Berzelius and Dr. Pontin also found that quicksilver negatively electrified in contact with solution of ammonia, expands to four or five times its former dimensions, and becomes a soft solid, which reproduces ammonia and quicksilver when exposed to air or water, evolving hydrogen in the latter fluid.

On repeating this important experiment, it was found that a considerable time was required to form an amalgam with 50 or 60 grains of quicksilver, in contact with a saturated solution of ammonia; and this amalgam became greatly changed even in the time required for removing it from the solution.

In a former paper it was shewn that ammonia is disengaged from ammoniacal salts at the negative surface; and may thus be

acted upon in its nascent state. Fifty grains of quicksilver were introduced into a cavity made in a piece of muriate of ammonia slightly moistened, and placed on a plate of platina rendered positive, while the quicksilver was made negative by a platina wire. A strong heat and effervescence took place; the globule increased to five times its former bulk, and resembled amalgam of zinc, from whence arborescent metallic crystallizations shot as from a centre round the body of the salt, and often became coloured where they touched the muriate. If broken they rapidly disappeared, emitted ammoniacal fumes, and reproduced quicksilver.

Quicksilver on moistened carbonate of ammonia exhibited the same appearances; but a black matter formed in the cavity, which substance was probably carbone arising from the decomposition of the carbonic acid, like the black matter separated at the negative surface, when potash or soda, containing some carbonic acid, is decomposed.

The strong attraction of the metallic bases of the fixed alkalies, and of the earths, for oxygen, induced a suspicion that they might produce the amalgam of ammonia independent of the action of electricity. Quicksilver united with potassium, sodium, barium, or calcium, acting upon moistened muriate of ammonia, rapidly increased to six or seven times its former size, and seemed to take up more ammoniacal basis than by electricity; but as a portion of the other metal is present, it was only the amalgam obtained by electricity that was examined.

This amalgam, at 70 or 80°, is of the consistence of butter; at the freezing temperature it forms a crystallized mass, in which small facets appear, which seem to be cubical. Its specific gravity is less than three. Confined in a given quantity of air, the air enlarges in volume, and the quicksilver is left pure; ammoniacal gas, equal to 1 and an half or 1 3-5ths the volume of the amalgam, is produced, and oxygen, equal to 1-7th or 1-8th of the ammonia, disappears. Thrown into muriatic acid gas, it becomes coated with muriate of ammonia, and hydrogen is disengaged. In sulphuric acid it becomes coated with sulphate of ammonia and sulphur.

Quicksilver retains moisture with such perseverance, that it is scarcely possible to separate the moisture from the amalgam; especially as 60 grains of quicksilver only take up 1-200th of a grain of the basis of ammonia, and this requires scarcely 1-1000th of a grain of water to supply the oxygen necessary to oxidize it. When, therefore, an amalgam, wiped by bibulous paper, is introduced into naphtha, it decomposes almost as rapidly as in air, producing ammonia and hydrogen. In oils it formed ammoniacal soap, and evolved hydrogen; and when introduced into a glass tube closed by a cork, a gas consisting of from 2-3ds to 3-4ths ammonia, and the remainder hydrogen. The amalgam, wiped as dry as possible, being heated in a glass tube, was found to contain

moisture sufficient for its decomposition, as a saturated solution of ammonia was found in the tube.

Triple amalgams of ammonia by means of the metals of the earths or of the fixed alkalies, scarcely produce any ammonia under naphtha or oil; and when preserved for some time in closed glass tubes, only a little hydrogen is evolved from them.

Amalgam of ammonia-and-potassium required a considerable temperature before any gas was emitted: on cooling the tube after the whole of the amalgam was expelled, the mercury rose rapidly in it, until only half the bulk of the amalgam of gas remained. This gas did not alter its volume when oxygen was added to it: one half of it was absorbed by naphtha, and from the effect produced by the naphtha on turmeric, appeared to be ammonia; the remaining gas was found to consist of the oxygen introduced, and of hydrogen and nitrogen in the proportion of 4 to 1.

This triple amalgam was very little affected by concentrated solution of ammonia, and when moistened with it, only evolved a little hydrogen by keeping, but on heating the tube a gas consisting of 2-3ds ammonia and 1-3d hydrogen was evolved.

When the amalgam is wiped, a small quantity of ammonia, and perhaps potash, adheres to it, so that when the water is raised in vapour it oxygenizes the bases of ammonia and potash; hydrogen is evolved and ammonia is produced.

Amalgam of ammonia-and-potassium being distilled in a tube filled with the vapour of naphtha, yielded quicksilver, ammonia, hydrogen, and nitrogen; the residuum was potassium, which acted powerfully on the glass.

On heating an amalgam of potassium in ammoniacal gas, it became covered with a film of potash, but did not increase in size, and gas was produced, consisting of 5 parts of hydrogen and 1 of nitrogen. The amalgam did not afterwards emit ammonia by exposure to air: hence it would appear that the alkali must be either in a nascent state, or as it exists in ammoniacal salts, in order to form a metal.

The above results are very extraordinary, as here quicksilver by the addition of only about one 12000th of its weight of new matter is rendered solid, and less than 3 times as heavy as water, although it retains its metallic characters unimpaired.

Are hydrogen and azote, both metals in the aëriform state? or, as Mr. Cavendish asked, are they oxides which become metallized by deoxygenizement? or, as Prof. Berzelius thought, are they simple bodies not metallic in their own nature, but capable of composing a metal in their disoxygenized, and an alkali, in their oxygenized state?

Amalgam of potassium heated in contact with either hydrogen or nitrogen did not reduce them to a metallic state.

It was formerly stated (see page 183) that the metals and simple solid inflammables might be considered as compounds of hydrogen with peculiar unknown bases, and the oxides, alkalies, and

acids, as compounds of the same bases with water; and these experiments offer rather stronger evidences in favour of that hypothesis, although it would be less distinct and simple than that of Lavoisier. The novel analogies in electro-chemical science are indeed in favour of a common principle of inflammability. Oxygen is the only body that can be thought elementary which is attracted by the positive surface in the electric circuit, and all compounds attracted by that surface contain a considerable proportion of oxygen : hydrogen is the only body attracted by the negative surface which can be considered as opposite to oxygen : may not then hydrogen be contained in all the metallic and inflammable bodies supposed to be simple ?

Other hypotheses might be formed upon the new electro-chemical facts, in which still fewer elements might be maintained, as certain electrical states always coincide with certain chemical states of bodies. Thus acids are uniformly negative, alkalies positive, and inflammables highly positive ; again, acids positively electrified, and alkalies negatively electrified, lose their peculiar properties and powers of combination. In these instances the chemical qualities depend on the electrical powers, and of course matter of the same kind possessed of different electrical powers may exhibit different chemical forms.

On this theory water positively electrified, would be hydrogen, and the same negatively electrified, oxygen ; and as ice added to a certain quantity of steam, produces water alone, so the electrical energies in certain proportions, would annihilate each other, and water be formed. Ammonium, or the basis of ammonia, would owe its attraction for oxygen to its highly positive state, and may be supposed to be a simple body, which by combining with different quantities of water, and in different electric states, forms nitrogen, ammonia, atmospheric air, nitrous oxide, nitrous gas, and nitric acid.

On the phlogistic hypothesis, nitrogen with 1-4th its weight of hydrogen forms an alkali, and with 1-12th more, becomes metallic, which is contrary to the order of common chemical facts. On the antiphlogistic hypothesis, although nitrogen has less attraction for oxygen than hydrogen, yet a compound of hydrogen and nitrogen can decompose water. This assumption is less violent than the other, for alloys are more oxidizable than their component metals; so also sulphuret of iron decomposes water at the ordinary temperature, and the compound of phosphorus and hydrogen is more inflammable than either of them separately.

The above facts tend to explain some of the phenomena of nature. The metals of the earths and alkalies cannot exist at the surface of the earth ; but if they exist in large quantity beneath the surface, their accidental exposure to the action of air and water must produce the effect of subterranean fire, and the formation of lavas. The luminous appearance of the meteors connected with the fall of stones may arise from their coming into our atmosphere in a metallic state, and being afterwards kindled.

A number of experiments were made on the action of potassium on bodies supposed simple, and on the undecompounded, acids which will form the subject of future papers, the general results only being here mentioned.

Potassium heated in dry muriatic acid gas produced ignition, the acid gas disappeared, from 1-3d to 1-4th of its bulk of hydrogen was evolved, and muriate of potash was formed. This indicates at least 1-8th or 1-10th of its weight of water to be contained in the gas; a much larger proportion than is stated by Dr. Henry. Chemists who suppose hydrogen to be the basis of the muriatic acid, may perhaps give another explanation, and consider this as a proof of their opinion.

Potassium produced a similar effect on fluoric acid gas, but only 1-6th or 1-7th of its bulk of hydrogen was evolved, and there was left a white mass principally composed of fluate of potash and silex, but which emitted fumes of fluoric acid when exposed to air.

When boracic acid that had been ignited, was heated in a gold tube with potassium, a minute quantity of hydrogen mixed with nitrogen, probably from the common air in the tube, was evolved, borate of potash was formed, and a black substance which became white by exposure to air.

In these two last experiments, the hydrogen seems to arise from water adhering to the acids, although it is probable that they are decomposed, as the black matter from the boracic acid is similar to that obtained from it by electricity.

Since this paper was read to the Society, an account has been received of the experiments of Messrs. Gay Lussac and Thenard, from one of which they have concluded that potassium may be a compound of hydrogen and potash.

They found that heated potassium absorbed ammonia, and became of a grayish green colour, evolving 2-3ds of its bulk of hydrogen. This grayish green substance being heated again emitted 2-5ths of the absorbed ammonia, with hydrogen and nitrogen equal to another fifth. By adding water to the mixture and heating it strongly, the remainder of the ammonia was obtained, and nothing but potash was left.

But the idea of these chemists cannot be admitted. Potash does not absorb ammonia when heated with it, and therefore it is unlikely that ammonia should expel hydrogen from potassium. Part of the hydrogen may proceed from water in the gas, but scarcely the whole; for then the gas must contain one-half its weight of water, and the whole might proceed from the ammonia.

That mere potash combined with hydrogen cannot form potassium is evident from a fact lately discovered by the above French chemists. Potash that had been kept ignited for an hour being brought into contact with iron ignited to whiteness, hydrogen was evolved, and two solid products obtained, the one a fixed white

alloy of iron and potassium, the other a small quantity of a sublimate which burnt when thrown on water, and in other characters resembled pure potassium, except that it was heavier, less brilliant, and became tarnished of a much deeper colour.

Dry potash must therefore, on their theory, not only contain water sufficient to metallize the alkali, but likewise the quantity that is emitted.

Nevertheless potassium may be readily produced from dry ignited potash, by electricity, and the alkali arising from the combustion of potassium slakes violently when water is added to it. In treating potassium with ammonia, the hydrogen disengaged at first, and that existing in the ammonia afterwards disengaged, exactly equals that originally contained in the ammonia.

The properties of potassium are unlike what might be expected in a compound of potash and hydrogen; it acts on water with more energy than potash, and produces much more heat. It also burns in carbonic acid, depositing carbone; whereas hydrogen electrified with that acid, changes it into gaseous oxide of carbone. It also separates phosphorus from hydrogen with inflammation, while potash has only a slight attraction for phosphorus, and none for arsenic, yet potassium separates arsenic from arsenicated hydrogen.

Observations.—The discoveries that Mr. Davy made respecting the agency of galvanism in operating those decompositions which resisted the ordinary agents used in chemistry, naturally led the way to the preceding experiments, evincing the alkaline earths, viz. lime, barytes, strontian, and magnesia, to be capable of metallization by the same mode as the common oxides. These earths have always been deemed to differ from silica and alumine, and to assimilate strongly either to the more simple saline matters, (i. e. to oxygenized inflammables) or to the metallic oxides.

It is evident from Mr. Davy's recital that the metallization of silica, alumina, glucine, and zircone, still admits of dispute.

The rapid oxidizement of the metals of the alkalies and alkaline earths, and the consequent formation of the latter, will no doubt admit of many happy applications to geological phenomena, and may explain the formation of meteoric stones, as hinted at by the ingenious author.

We are glad that Mr. D. has abstained from shifting the names of the alkalies and alkaline earths to the metals produced from them, and has preferred forming new names for new things; as he has by that means avoided the increase of the equivocal terms which are the opprobrium of modern chemistry. Should the use of a systematic nomenclature be persisted in, as rigidly as it has been of late, it will be of course necessary to change the names of all the alkaline and earthy salts; but it is more probable that chemists will rest satisfied with the innovations that have already taken place in the language of their science.

On the Changes produced in atmospheric Air, and Oxygen, by Respiration. By Messrs. W. Allen *and* W. H. Pepys.—*Phil. Trans.* 1808, *Part II.*

The process of respiration, or breathing, is so necessary to life, that it merits the strictest investigation. Many philosophers have thrown some light upon it, but many important points were left unsettled; from the imperfection of the means for analysing the aëriform fluids, and still more from the residual gas left in the lungs being unknown as to its quantity, and also bearing a large proportion to the small quantities of gases used in former experiments. To avoid which source of error, the following experiments were made with a water gasometer capable of holding 4200 cubic inches of gas; to which were annexed two mercurial gasometers, each holding about 300 cub. in. and connected with jars standing in a mercurial trough, in order that small portions of the expired air might be saved and examined from time to time.

Experiment 1. 3760 cub. in. of common air were inspired out of the water gasometer, and received in the mercurial gasometers, of which one was measured, and a specimen saved, while the other received the expired air; the total sum of which was 3741 cub. in.

Exp. 2. 3900 cub. in. of common air were inspired in 11 minutes, and the expired air measured 3869.

Exp. 3. 3624 cub. in. of common air were inspired in 10½ min.: the expired air measured 3620.

Exp. 4. 3570 cub. in. of common air were expired in 10½ min.: the expired air measured 3550.

Exp. 5. 3685 cub. in. of common air were inspired in 11 min.: the expired air measured 3653.

Exp. 6. 3380 cub. in. of common air were inspired in 11 min.: the expired air measured 3355.

Exp. 7. 3180 cub. in. of common air were inspired in 10½ min.: the expired air measured 3141.

Exp. 8. 3360 cub. in. of common air were inspired in 10½ min.: the expired air measured 3298.

Exp. 9. 3290 cub. in. of common air were inspired in 10½ min.: the expired air measured 3267.

Exp. 10. 3580 cub. in. of common air were inspired in 11 min.: the expired air measured 3543 cub. in. and contained 8 per cent. of carbonic acid.

The breathing in the experiments was as nearly natural as possible, the pulse was not raised more than one beat in a minute, although the respirations were deeper and fewer than in the open air, being only about 58 in 11 minutes, instead of 19 in a minute.

The decrease of the air when expired, amounted, as above, to from 4 to 62 cub. in. which is much less than was expected from prior experiments. Even this decrease probably arose from the difficulty of bringing the lungs precisely to the same state after the experiment, as they were before it.

Exp. 11. Bar. 30.4 in. Therm. 50° Fahr. 3460 cub. in. of common air, containing as usual 21 per cent. of oxygen, and 79 of azote, were inspired in 11 min. The expired air measured 3437 cub. in. and contained 8.5 per cent. of carbonic acid, 12.5 of oxygen, and 79 of azote, as appeared on analysing a mixture of the several specimens taken from the mercurial gasometers as they were filled. So that 292.14 cub. in. of carbonic acid gas were given off in 11 minutes, or 26.55 cub. in. per min. as formerly estimated by Mr. Davy. And it also appears that this person took in $16\frac{1}{2}$ cub. in. of common air at every easy inspiration.

Exp. 12 was made by the person, who in all the other experiments registered the results.

Bar. 30.3 in. Therm. 56° Fahr. 3300 cub. in. of common air were inspired in $5\frac{1}{2}$ minutes. The expired air measured 3311 cub. in. and contained 8.5 per cent. of carbonic acid, 12.5 of oxygen, and 79 of azote. The excess of 11 cub. in. probably arose from the inexperience of the operator in exhausting his lungs, which also appeared to be of greater capacity than those of the person who made the other experiments. Here 51 cub. in. of carbonic acid were given off per minute: and it appears that whenever common air is taken into the lungs, it returns charged with about $8\frac{1}{2}$ per cent. of carbonic acid.

Exp. 13. In order to carry on the respiration of common air for a much longer period; after nearly the whole of the air in the water gasometer was expired into the mercurial gasometers by alternation, the operator continued to breathe the air expired into the last used mercurial gasometer, while the water gasometer was replenished.

Bar. 29.85 in. Therm. 68° Fahr. 9890 cub. in. of common air were inspired in 24 min. 37 seconds. The expired air measured 9872 cub. in. The operator felt scarcely any fatigue, and finished the experiment by a forcible expiration of 166 cub. in. The expired air contained 8 per cent. of carbonic acid, 13 of oxygen, and 79 of azote; and of course 32 cub. in. of carbonic acid were given off per minute.

In ordinary respirations a great part of the air seems to be returned unaltered. There is also a considerable difference in the quality of the first and last portions of a single inspiration. The first portions contained only from 3 to 5 per cent. of carbonic acid. A forced expiration of 204 cub. in. contained on the whole 9.5 per cent.: and therefore the last portions would have been

found to contain more than that proportion, although the medium is only about 8 per cent. as above.

Exp. 14. 300 cub. in. of common air were inspired out of one mercurial gasometer into the other, alternately, until respiration became extremely laborious. This air, after having passed 8 or 10 times through the lungs in 3 min. contained 9.5 per cent. of carbonic acid, 5.5 of oxygen, and 85 of azote. Here 6 parts in the hundred of oxygen appeared to be converted into gaseous oxide of carbone, carburetted hydrogen, or some other gas not absorbable by lime-water, or the tests for oxygen.

Now gaseous oxide of carbone is converted into carbonic acid gas, by mixture with hyperoxygenised muriatic acid gas, procured from hyperoxygenised muriate of potash, by means of muriatic acid: and hence that gas, and probably also carburetted hydrogen, may be detected in the expired gas.

Exp. 15. 300 cubic inches of common air contained in one of the mercurial gasometers, were respired. In less than a minute it became necessary to take deeper and deeper inspirations, and at last the efforts of the lungs were so violent that the glass was in danger of being broke. A great sense of oppression and suffocation was now felt in the chest, vision became indistinct, and after the second minute the attention of the operator seemed to be withdrawn from the surrounding objects, and fixed upon the experiment. A buzzing in the ears took place, as in breathing nitrous oxide; and after the third minute, there was left only sufficient recollection to close the gasometer after an expiration. After which he became insensible, having made 35 inspirations. The expired air contained 10 per cent. of carbonic acid, 4 of oxygen, and 86 of a residuum which was not affected by hyperoxygenised muriatic acid, and was consequently pure azote. This apparent increase of the azote seems owing to the absorption of 24.42 cub. in. of the oxygen, assuming the volume of the carbonic acid to equal the oxygen employed in its formation.

In like manner the apparent excess of azote in the 14th experiment, seems to arise from the absorption of 21.18 cub. in. of oxygen, as from the 11th, 12th, and 13th, the lungs do not appear capable of fixing permanently any azote from the atmosphere, or but a very minute quantity which is not appreciable by the eudiometer.

The 11th experiment seems to have given the average quantity of carbonic acid formed by respiration, and therefore, correcting the volume of the gas to the pressure of 30 inches, and temperature of 60° Fahr. it appears that 39534 cub. in. of oxygen are consumed in 24 hours, and an equal volume of carbonic acid gas formed. As 100 cub. in. of carbonic acid gas weigh 47.26 grains, and contain, according to the experiments on diamond (see vol. iii. p. 534), 28.6 per cent. of carbone, it will follow that above 11 oz.

Troy of solid carbone are emitted by the lungs in 24 hours. But when we consider that a smaller quantity of air comes in contact with the lungs in respiration in the open air, the proportion of carbonic acid is probably somewhat less.

Exp. 16. Bar. 29.5 in. Therm. 53°. Pulse 72. 3260 cub. in. of oxygen gas from hyperoxygenised muriate of potash, containing 2.5 per cent. of azote, were inspired in 9 min. 20 seconds. A general glow over the whole body to the very extremities, was felt with a gentle perspiration; these went off in a few minutes. The pulse was raised to 88. The expired air measured 3193 cub. in. and contained 11 per cent. of carbonic acid, 83 of oxygen, and 6 of azote: so that 37.64 cub. in. of carbonic acid per minute were formed. As this rate is superior to that when common air was respired, it may be inferred, that one use of azote is to regulate the quantity of oxygen which is to be taken up in the act of respiration.

It also appears that the original quantity of azote was apparently increased by 110.08 cub. in. besides what remained in the lungs after the experiment; while 177.08 cub. in. of oxygen were missing. From the 14th and 15th experiment it may be concluded that the air left in the lungs after the forced expiration at the beginning of the experiment contains about 84 per cent. of azote; and as the quantity of this gas may be very considerable after the most violent attempts at expiration, it is probable that this azote must have been displaced by the deep inspiration of the oxygen. Admitting the air left in the lungs after the experiment to contain the same proportion of azote as the expired gas, it is evident from calculation that 141 cub. in. of gas remained in the lungs at the commencement of the experiment. But the residual quantity in the lungs must vary according to the exertion made, and perhaps according to the state of the muscular fibre.

Exp. 17. Bar. 30.3. Therm. 70° Fahr. Pulse 86. Heat under the tongue 98$\frac{3}{4}$°. The operator, who had been rather fatigued for five hours, and had not taken any refreshment, respired 3420 cub. in. of oxygen, containing 2.5 per cent. of azote, in 7 min. 25 seconds. A gentle glow and universal perspiration was experienced, and the breathing was perfectly easy. The pulse after the experiment was 102, and the heat under the tongue 99°. The expired gas measured 3362 cub. in. of which the first 250 contained 9 per cent. of carbonic acid, 25 of azote, and 66 of oxygen. The next 562 cub. in. contained 10 per cent. of carbonic acid, 10 of azote, and 79.5 of oxygen. The last 168 cub. in. was the whole of a single and forcible expiration to empty the lungs; and contained 12.5 per cent. of carbonic acid, 5.5 of azote, and 82 of oxygen. A mixture of all the specimens except that of the first 250 cub. in. and of the last 168, contained 12 per cent. of carbonic acid, 6 5 of azote, and 81.5 of oxygen. From which it may be concluded that the lungs must be cleared of azote before the increased proportion of carbonic acid can take

place, and also that 7½ minutes are not sufficient to remove the azote from the extremities of the bronchiæ. The total quantity of carbonic acid formed was 396.78 cubic inches. There was an apparent increase of 177.60 cubic inches of azote, wherefore the lungs must have previously contained 262 cubic inches of gas, containing 84 per cent. of azote as above stated.

The deficiency of oxygen in these two last experiments, viz. 67 cubic inches in the former, and 58 in the latter, though but small, is greater in proportion than with common air; it seems probable, therefore, that some part of it may be detained in the system.

Exp. 18. Bar. 30.15. Therm. 70° Fahr. Pulse 84. Heat under the tongue 98°. 3130 cubic inches of oxygen were inspired in 8 minutes 45 seconds. The expired air measured 3060 cubic inches; the pulse, after the experiment, was 96, and the heat under the tongue still 98°. The same gentle glow and perspiration was felt as before. The first 196 cubic inches of the expired air contained 9 per cent. of carbonic acid, 22 of azote, and 69 of oxygen; the last 223 contained 12 per cent. of carbonic acid, 5 of azote, and 83 of oxygen. The intermediate specimens met with an accident.

On the whole, it appears that there is no reason to suppose that any water is formed by an union of oxygen and hydrogen in the lungs. When respiration is attended with distressing circumstances, a portion of oxygen seems to be absorbed, and as the oxygen decreases in quantity, perception gradually ceases. A larger proportion of carbonic acid is formed by the human subject from oxygen than from common air. An easy natural inspiration is from 16 to 17 cubic inches in the subject of these experiments, who makes about 19 in a minute. The quantity of carbonic acid formed in perfectly natural respiration in the open air is probably considerably less than here stated. No hydrogen, nor any other gas, is evolved in respiration.

Observations.—Notwithstanding the parade of arithmetical calculations with which this paper is loaded in the original, the results can still be considered but as imperfect approximations, whose value is only superior to those of former experimenters, from the volume of gas operated upon being considerably larger, on which account the result is less affected by the air previously existing in the lungs, or left in them at the conclusion.

The authors, in order to explain the surcharge of azote, in the experiments with oxygen, assume the hypothesis, that the air left in the lungs at the commencement of the process, although the previous respiration had been made in the open air, is loaded with the same large proportion of azote as when the same air was purposely respired, until the operator became insensible; while, on

the other hand, the air left at the end of the experiment, is supposed to contain no more azote than the expired gas. This seems a very strong assumption, and far distant from any degree of verisimilitude. No absolute certainty can be obtained on this head; but might it not be more reasonable to suppose that the residual gas contains azote in some certain proportion to the azote contained in the last portions of expired gas?

Description of an Apparatus for the Analysis of the compound inflammable Gases by slow Combustion; with Experiments on the Gas from Coals. By Dr. WILLIAM HENRY.—*Phil. Trans.* 1808, *Pt. II.*

THE analysis of the aëriform combinations of hydrogen and carbone, is one of the greatest difficulties in practical chemistry, and has hitherto only admitted of imperfect approximations to it.

When a compound of oxygen, hydrogen, and carbone, is ignited in close vessels, the elements composing it are united in new forms. Those inclined to enter into aëriform combinations make their escape as gases. The carbone saturating itself with oxygen forms carbonic acid, or by taking up less oxygen, composes carbonic oxide. The hydrogen combining with different proportions of carbone forms either carburetted hydrogen, or supercarburetted hydrogen, commonly called olefiant gas. Towards the close of the process, pure hydrogen is sometimes evolved. None of these gases are expelled in a pure state, but mixed together so as to have almost every possible specific gravity, and to yield by combustion extremely different results.

It is disputed, however, whether the gases as originally expelled, are not themselves ternary compounds, or varieties of oxy-carburetted hydrogen; but the idea of their being mixtures of binary compounds, as stated above, seems most probable, and is taken for granted in this paper.

These gases have hitherto been analysed by inflaming a mixture of the gas with oxygen by the electric spark in an eudiometer, ascertaining its diminution, and afterwards separating the carbonic acid gas that is formed by lime-water. In the subsequent estimate it is assumed, that the carbone has taken up the whole of the oxygen necessary for its acidification, and that no carbonic oxide existed in the gas, which, in many cases, is false, and, in some, the whole of the carbone is not oxygenized, as charcoal is precipitated on the eudiometer. The products of the combustion of the same gas varied considerably in different experiments. Only minute quantities of the gases can be operated upon in an eudiometer, and the inflammation of the highly combustible gases is attended with great danger, as the glass tubes may burst.

For the mere purpose of approximation, it is sufficient to examine the coincidence of the results of this combustion with that of the gases that appear to be distinct species.

The specific gravity of olefiant gas is to air as 909 to 1000. 100 measures of it consume 300 of oxygen in combustion, and produce 200 of carbonic acid.

The specific gravity of carbonized hydrogen from stagnant water is 600. 100 measures consume 200 of oxygen, and yield 100 of carbonic acid.

The specific gravity of carbonic oxide is 967. 100 measures consume 45 of oxygen, and yield 90 of carbonic acid.

The specific gravity of hydrogen is 84. 100 measures consume 50 of oxygen, and it does not produce any carbonic acid.

To avoid the inconveniencies of Volta's eudiometer, a new apparatus, in which a larger quantity of gas may be slowly burned at a time, is proposed.

This apparatus consists of two graduated cylinders; the one containing the inflammable gas to be examined, the other, the oxygen for its combustion. The first is secured in a glass jar holding water, by wedges of cork; and as it has a glass tube proceeding from the top of it, the efflux of the gas is regulated by means of an afflux of water from a reservoir. The tube is connected to this cylinder by two cocks screwing into one another, so that when the experiment is finished, the tube may be unscrewed without the external air getting either into the cylinder or tube. The tube is bent so as to pass through a trough of water or quicksilver, and into the cavity of the other cylinder, supported in it by a frame. The top of this tube is mounted with an iron cone pierced with a small hole about 1-30th of an inch in diameter, to which is annexed a metallic wire, serving to complete the electric circuit.

The cylinder destined to hold the oxygen is closed at top by a brass cap with a cock, by which the cylinder may be connected at pleasure, to a transferrer, or air-holder. To the internal orifice of this cock is screwed a brass wire, which can be lengthened or shortened, so that the ball by which it is terminated may be at a proper distance from the end of the tube for a rapid succession of electric sparks to be made to pass from one to the other, by means of an electrical machine.

The combustion continues until either the whole of the inflammable gas is consumed, or until the communication between the cylinder is stopped by shutting the cock at the end of the tube. After the combustion, the upper part of the cylinder holding oxygen, is cooled by a wet sponge, and a thermometer introduced into it. The proportion of carbonic acid is determined by liquid potash, and the proportions of oxygen and azote in the residuum by sulphuret of lime. The gases are reduced by calculation at each stage of the operation to the temperature of 60° Fahr. and pressure of 30 inches.

The calculation is rendered imperfect by a part of the inflammable gas which escapes through the orifice of the tube without burning; as this portion is not absorbed by sulphuret of lime, it gives the appearance of more azote than is really contained in the residuary gas. Some of this inaccuracy may be avoided by causing the gas at first to issue in a gentle stream: when, however, the flame is once kindled, the more active the combustion within certain limits, the more completely is the gas consumed. It is also necessary to stop the combustion before it is rendered languid by the carbonic acid produced, or by the diminished purity of the oxygen.

The inflammable gas that finds its way into the oxygen, is not in sufficient quantity to be detonated by the electric spark after the carbonic acid has been separated. The mixed gas must therefore be mixed with hydrogen, not exceeding 1-3rd or 1-4th of the oxygen it is supposed to contain, and then detonated.

It may be thought that the products of this slow combustion are disguised by reason of some of the carbonic acid that is formed, being absorbed by the water; but when the operator has acquired adroitness by practice, the error thence arising is too trivial for consideration.

This apparatus being tried for the combustion of pure hydrogen, the receiver for the inflammable gas contained, when reduced to a mean temperature and pressure, 15.8 cubic inches; of which there remained unconsumed 2.5. In the other receiver were 49 cubic inches of oxygen, consisting of 33.5 oxygen, and 15.5 azote; which at the end of the combustion were reduced to 43.5 cubic inches, consisting, by eudiometrical experiments, of 27.25 oxygen and 16.25 of some other gas. As the hydrogen was extremely pure, this apparent increase of the azote may be imputed to the escape of hydrogen into the oxygen, so that the true consumption of the hydrogen was 12.55 cubic inches, and that of the oxygen 6.25; or, as it ought to be, half the bulk of the hydrogen.

In another experiment, the inflammable gas obtained from alkohol and sulphuric acid was employed: 100 cubic inches of this gas weighed 30 grains, and, of course, its specific gravity was 967. The receiver contained 6.3 cubic inches of this gas, of which there remained 2. The other vessel contained 43.4 cubic inches of oxygen; after the combustion there remained 38.2 of mixed gases, of which 8.6 were carbonic acid. None of the inflammable gas that passed into the oxygen had escaped being burned; 13.8 cubic inches of oxygen therefore was consumed. Thus 100 cubic inches of this olefiant gas absorb 325 of oxygen, and yield 200 of carbonic acid; but the gas was heavier than that used by the Dutch chemists, the specific gravity of which was only 909.

This apparatus was employed for the combustion of those gases, that, probably, might become economical sources of light.

The gas from Wigan cannel-coals was received in two portions. The specific gravity of the first was 783. 7.3 cubic inches of it absorbed 16.5 of oxygen, and produced 8.3 of carbonic acid; the residuum being mixed with some hydrogen, and detonated, absorbed 0.9 of oxygen, and produced 1.9 of carbonic acid; hence, 100 of the gas absorb, in the whole, 234 of oxygen, and form 139.7 of carbonic acid. This portion of gas, before being washed with lime-water, or caustic potash, is a mixture of carbonic acid, sulphuretted hydrogen, olefiant gas, and another, which is either a peculiar gas, or a mixture of carburetted hydrogen and carbonic oxide: to ascertain their proportions is a matter of difficulty.

Sulphuretted hydrogen and olefiant gas are condensed by mixture with oxy-muriatic acid gas, and may thus be separated from carbonic acid. On the other hand, sulphuretted hydrogen and carbonic acid are absorbed by liquid potash, which has no action on olefiant gas. By the combined use of these agents, an approximation may be obtained to the proportion in which carbonic acid, olefiant gas, and sulphuretted hydrogen are mixed with the aëriform products of coal. The remaining portion of gas varies essentially in different cases, and its component parts are still doubtful.

This mode of analysis was applied to the gas from cannel-coal. Oxy-muriatic acid gas was added to twice its bulk of coal gas, and the diminution at the end of one or two minutes was observed. An equal quantity of the gas was washed with caustic potash, the loss noted, and the residue mixed with oxy-muriatic acid; the diminution thus obtained, divided by 2.2, shewed the quantity of olefiant gas. Deducting this absorption from the first, and dividing the remainder by 1.8, the quantity of sulphuretted hydrogen was obtained. And the quantity of carbonic acid was found by subtracting from the diminution by caustic potash, the quantity of sulphuretted hydrogen.

In this manner, the first product of gas from cannel-coal was found to contain 5.3 per cent. in bulk of sulphuretted hydrogen, 4.4 of carbonic acid, 4.9 of olefiant gas, and 85.4 of inflammable air, not affected by the above agents.

The second product of gas was of the specific gravity of 335. 9.8 cubic inches of it absorbed 9.4 of oxygen, and produced 4.8 of carbonic acid. It contained 1.8 per cent. of carbonic acid, and 98.2 of residuary inflammable air.

From a number of similar experiments, the following general remarks are deduced.

Olefiant gas is found only in the first portions of gas from coal, and does not compose more than 5 per cent. of them. Like all the aëriform products of coals, its quantity is much influenced by the temperature employed. The gas from Colebrooke-dale tar, and that from caoutchouc, contain 1-6th of its bulk of this gas.

Sulphuretted hydrogen composes, at first, from 1 to 5 per cent. of the produce, but towards the close of the process it disappears entirely. It increases the illuminating power of the gas, but produces by combustion, sulphurous acid, which is extremely offensive, and irritates the lungs. In distilling coals, part of this gas unites with the ammonia that is formed.

Carbonic acid also appears only at the beginning of the process, and never amounts to 5 per cent. Part of this gas also unites with the ammonia produced at the same time

The gas from coals becomes gradually lighter as the distillation advances. Its specific gravity affords a measure of its fitness for illumination sufficiently accurate for practical purposes. It does not precisely answer to any of the known gases. The first product, after being washed with potash, approaches to carburetted hydrogen. The heavier gases are mixtures of carburetted hydrogen with olefiant gas, and perhaps a small portion of carbonic acid. The lighter gases, besides carburetted hydrogen, probably contain hydrogen, and a small portion of carbonic acid.

One hundred cubic inches of coal gas of medium quality, such as the first product from Newcastle-upon-Tyne coal, weighs 333.5 grains. As it yields by combustion 817.3 grains of carbonic acid, it probably consists of 233.7 carbone, and 99.8 of hydrogen; but as it consumes only 1110.3 grains of oxygen, a small portion of the gas seems to be in the state of carbonic oxide.

Gas of inferior quality weighs 169.3 grains per cubic foot, which consists of 111.5 carbone, and 57.8 hydrogen. It consumes 560 grains of oxygen, and forms 400 of carbonic acid, so that here also the carbone is probably already combined with some oxygen.

The decomposition of these gases is necessarily imperfect until the water formed can be determined. Many contrivances have been tried for this purpose, but none have been as yet satisfactory.

Different species of coals yield gases which differ in specific gravity and combustibility. The gas from Merthyr coal, and probably, the other coals that burn without flame or smoke, contains in the same bulk scarcely half as much combustible matter as gas from cannel-coal.

Unfortunately, the coal whose gas is best adapted for illumination, generally contains the largest proportion of sulphuretted hydrogen. Washing with water does not effect its entire separation, and the most practicable method that can be performed on a large scale seems to be agitation with a mixture of lime and water, of the consistence of cream.

Observations.—The imperfection of this apparatus and mode of research is evident, as it does not separate and determine the na-

ture of above 1-5th of the inflammable gas from coal; the composition of the remaining portion being left still unknown.

In our third volume, p. 196, may be found the experiments of Dr. Thomson, on the gas from peat; which paper may be considered as a companion to the present essay.

Mr. Heard (see also vol. iii. p. 83) has taken out a patent for purifying the gas from coal from sulphurous acid gas, by stratifying the coal in the distilling vessel with lime, or by passing the gas over lime heated in a tube; both which methods are inferior to that here proposed.

On the Difference in the Structure of Calculi, arising from the Part in which they are formed; and on the Effects produced on them by solvent Medicines. By Mr. William Brande'.—*Phil. Trans.* 1808, *Pt. II.*

This paper being rather more of a medical nature, than properly belonging to chemistry, our abstract of it will, of course, be short, and directed principally to the chemical results.

A calculus from the kidneys, weighing 7 grains, yielded on analysis, 4.5 grains of uric acid, and 2.5 of animal matter. Another weighing 3.7 grains, contained no less than 3.5 of uric acid.

It often happens that the ingredients are voided in a fine powder, called sand. This consists either of uric acid, or of the ammoniaco-magnesian phosphate alone, or with phosphate of lime. The two last-mentioned substances are never met with, till the urine has been in a state of repose, and therefore do not compose calculi in the kidneys.

Three calculi from the kidneys, in the Hunterian collection, are composed of oxalate of lime.

When these calculi are detained in the kidney, they increase sometimes to a considerable size, and sometimes consist wholly of uric acid and animal matter, or the external laminæ are composed of ammoniaco-magnesian phosphate, and phosphate of lime.

A small uric calculus having been deposited in the kidney, so as to have a continual stream of urine pass over it, was found to have beautiful crystals of the triple phosphate upon it.

Of 150 calculi of the urinary bladder, 16 were composed of uric acid; 45 of uric acid, with a small proportion of the phosphates; 66 of the phosphates, with a small proportion of uric acid; 12 of the phosphates entirely; five had nuclei of oxalate of lime, and consisted externally, of uric acid with the phosphates; and six were formed chiefly of oxalate of lime.

From many experiments upon the calculi, commonly supposed to consist of urate of ammonia, it appears that they contain urea, and that the evolution of ammonia depends, in all instances, upon the decomposition of the ammoniacal salts contained in the calculus, more especially of the ammoniaco-magnesian phosphate. The urate of ammonia, indeed, does not seem to exist in calculi; thus, a portion of a calculus supposed to be of this sort, weighing 60 grains, yielded 5.2 grains of urea and muriate of ammonia, six of ammoniaco-magnesian phosphate, and the remaining 48.8 grains were uric acid.

The mulberry calculi are rare; they usually contain a large proportion of phosphate of lime, and of uric acid. The purest afforded 65 per cent. oxalate of lime; 16 uric acid; 15 of phosphate of lime; and four of animal matter.

Large calculi are seldom homogeneous, and the ammoniaco-magnesian phosphate is usually in large proportion, and forms the external layer.

A calculus weighing 23 ounces and 26 grains, consisted of a nucleus of uric acid, enveloped by oxalate of lime, and then surrounded by very pure ammoniaco-magnesian phosphate. Another weighing $15\frac{1}{2}$ ounces, consisted of uric acid enveloped in the phosphate, which was intersected by several laminæ of uric acid. A calculus has also been seen, consisting of separate layers of uric acid, ammoniaco-magnesian phosphate, phosphate of lime, and oxalate of lime.

A calculous deposition on a common garden-pea, consisted of 65 per cent. phosphate of lime, 28 ammoniaco-magnesian phosphate, and seven were lost.

Another on a needle, contained 45 per cent. phosphate of lime, 38 ammoniaco-magnesian phosphate, 12 oxalate of lime, which appeared to have been accidentally deposited, and five were lost.

A third upon a piece of a bougie was covered with blood, and consisted chiefly of phosphate of lime.

A fourth upon a hazel-nut was also destitute of uric acid.

A calculus that had escaped from the bladder while very small, and lodged in the urethra, where it had increased in size and formed a cavity in which it was embedded, consisted of ammoniaco-magnesian phosphate, and phosphate of lime with a small portion of uric acid.

Another consisted entirely of the ammoniaco-magnesian phosphate.

A third was a perfect sphere, about half an inch in diameter, coated with regular crystals of very pure triple phosphate; the nucleus was not examined, but was, probably, a small kidney calculus.

A very large calculus from the kidney of a horse, contained 76 per cent. phosphate of lime, and 22 carbonate of lime.

Another from the bladder of a horse contained 45 per cent.

phosphate of lime, 28 ammoniaco-magnesian phosphate, 15 animal matter, and 10 carbonate of lime.

Sand which had nearly filled the bladder of a horse contained 60 per cent. phosphate of lime, and 40 carbonate of lime.

The small calculi that are frequently found in the bladder of the ox, consist of carbonate of lime and animal matter, which retains its form after the action of diluted acids.

A calculus from the kidney of a sheep contained 72 per cent. phosphate of lime, 20 carbonate of lime, and 8 of animal matter.

The urine of the rhinoceros is exceedingly turbid when voided, and deposits a large quantity of carbonate of lime with small portions of phosphate of lime, and animal matter.

A large calculus from the bladder of a dog, 20 years old, had a nucleus partly made up of concentric layers of phosphate of lime, and partly of crystals of ammoniaco-magnesian phosphate. The exterior part of the stone contained 64 per cent. phosphate of lime, 30 ammoniaco-magnesian phosphate, and 6 of animal matter.

Sand from a dog's bladder contained 20 per cent. carbonate of lime, and 80 phosphate of lime.

A calculus from the bladder of a hog contained 90 per cent. carbonate of lime, and 10 of animal matter.

A calculus from the bladder of a rabbit contained 39 per cent. phosphate of lime, 42 carbonate of lime, and 19 of animal matter.

From this statement of the composition of calculi many general inferences are drawn, but as they are of a medical nature, we pass them over, as not coming within the limits of our work. The paper is followed by another, in which Mr. Home, the surgeon, corroborates, from his own experience, the inefficacy of alkalies as lithontriptic medicines, and shews the fallacy which gave rise to that opinion.

Description of an Hydrometer for determining the specific Gravity of both Solids and Liquids. By Mr. George Atkins.—*Phil. Mag. No.* 124.

The specific gravity of bodies has always been considered as one of their most distinguishing characteristics; but although the hydrostatic balance is perhaps the best way of finding the specific gravity of a body, yet the difficulties attendant on the construction and use of that instrument are very great, and in many cases of real business its use would be impracticable, as the investigation must be entrusted to persons who have neither time nor knowledge sufficient to enable them to use the hydrostatic balance.

The hydrometer for spirituous liquors, and the saccharometer for malt liquors, are adapted only to their stated purposes: the

present is of universal application, and does not require more than half a pint of any liquid for the purpose of experiment.

It consists of a spheroidal bulb having a small stem, with a cup on its top to receive weights; and a shank beneath the bulb, with a pointed screw, to which is affixed a cup to receive weights or solids when their specific gravity is sought.

The weight of the hydrometer itself is 700 grains, and it is so adjusted, that when a weight of 300 grains is put into the cup on the top of the stem, it sinks in distilled water at 60° Fahr. to a mark on the middle of the stem.

In consequence of this adjustment, the specific gravity of the fluid in which the hydrometer is immerged will be indicated by the sum of the weight of the instrument, viz. 700 grains, added to that of the grains put into the upper cup to sink it to the proper depth. Thus, if on immerging the hydrometer in ether, it requires 34 grains weight to be added, to make it subside to the proper mark, the specific gravity of the ether would be $700+34 = .734$.

The specific gravity of a solid may be found, provided its weight does not exceed 300 grains, by putting it into the upper cup, and adding the necessary number of grains to sink the instrument to the mark, which number being subtracted from 300, is its weight in air: it is then to be put into the lower cup, and weighed in a similar manner, when immerged in water; from these data its specific gravity is found in the usual manner.

In order to weigh woods lighter than water, they must be screwed on the point of the lower shank.

Besides the mark on the middle of the upper stem, there are also divisions marked thereon, equal to tenths of grains in weight.

For the purposes of brewing, or dealing in spirituous liquors, a scale is attached to it, which shews the relations between the specific gravities, and the common technical denominations of per centage, or pounds per barrel. It would, however, be far better to let these arbitrary divisions fall into disuse, as the adoption of the universal expression of the specific gravities would enable a person to know what relation their practice may bear to that of others in the same pursuit.

Observations.—This seems to be only an adaptation of Nicholson's instrument to the purpose of finding the specific gravities of fluids by a single operation, without calculation; and with the addition of a screw, on which buoyant woods may be fastened when weighed in water.

On the Advantages of employing Coal-gas for lighting small Manufactories, and for other Purposes. By Mr. B. Cook.—*Philosophical Journal, No.* 94.

The rupture with Russia has increased the price of tallow, and of course that of soap, oil, &c. so that the advantage of using coal-gas is become more evident. It might indeed raise the price of coal a little, but this would only have the effect of inducing a stricter search after coal, which is to be found in almost every part of this country (the neighbourhood of Birmingham) if it were properly sought after.

The coak produced in the process would not exceed the demand, because it might be introduced into more general use. Three fires made from coak last in stoves longer than two from coals.

A spirit might also be made from the tar, instead of that imported from Russia; and the tar itself is a much better preserver of wood from worms, or from becoming rotten, than the common paint, or the common tar.

The apparatus, as used on a limited scale in a manufactory of gold and metal toys, is only an eight gallon cast-iron pot, with a cover of the same metal, luted on with sand. About 20 or 25 lbs. of coals are put into the pot, and distilled, which requires the combustion of about 25 lbs. more of coals. The quantity of gas produced varies according to the quality of the coals; it is passed through water into the reservoir, which only holds about 400 gallons, but in general more is produced; so that the overplus, perhaps 200 gallons, is wasted. From the reservoir the gas is conveyed round the shops by means of old gun-barrels, used as tubes, and coated once a year, or seldomer, with the produced tar.

The gas flame is found to be superior to that of a lamp, for soldering with the blowpipe. It is sharper, makes of course neater work, and the moment the stop-cock is turned, the flame is ready for use, while with oil and a cotton wick the workman is forced to wait until the lamp is sufficiently on fire.

The expense of putting up the apparatus was 50*l.* on account of not knowing the cheapest and readiest method; but it might be set up for 35*l.* or, to take every expense at the utmost, 40*l.*

The lights employed in the manufactory are 18 or 20, equal to eighteen shillings a week for candles, for 20 weeks, which amounts to 18*l.* It used to cost 30*l.* a year for oil and cotton for the soldering lamps; and the coak is certainly worth 2*l.* 10*s.* a year: so that, setting the tar against any little accident that may happen, the whole produce may be taken at 50*l.* 10*s.* a year.

Supposing 50lb. of coal is used daily, the weekly expenditure on that head will be 2*s.* and allowing part of a man's time to attend and make the gas to be worth 5*s.* the whole will be 7*s.* a week, or 18*l.* 4*s.* a year; this, however, is 1-4th more than it ought to be, because the gas will for 25 or 30 weeks not be required for lights. And adding to this expense 2*l.* a year for interest on the cost of the apparatus, there will remain a saving of 30*l.* 6*s.* in the year.

If erected on a smaller scale, for a poor manufacturer who uses only six candles, and one lamp, the apparatus put up in the cheapest way will cost only 10 or 12*l.* which he will nearly, if not quite, save the first year of using it.

A drawing and description of a small apparatus for the production and use of the coal-gas on a limited scale are promised.

Observations.—This is the only account we possess of the expense and produce of coal-gas when used on a small scale, the statement of Mr. Murdoch, noticed p. 198, referring to large manufactories.

As to lowering the price of tallow, it is well known that, if this be effected, the price of meat must of course be raised, and therefore, as food is of more consequence than artificial light, it is rather to be deprecated. Thus we find, that in Russia as the value of the hide and tallow is almost equal to that of the beast itself, the meat is sold at a very low rate; and at Buenos Ayres, from a similar reason, the meat sells for only the expense of cutting up and carriage.

On the Fecula of Potatoes, and some other British Vegetables. By William Skrimshire, *Junr.*—*Phil. Jour. No.* 93.

This is a continuation of the paper of which we gave an abstract in p. 286.

One thousand gr. of the roots of potatoes called hundred eyes, not full grown, yielded by the same manipulation as formerly described 99 gr. of fine white fecula, 6 of discoloured fecula, 71 of dry pulp, and 817 of water, soluble mucilage, and extractive matter: but by these roots being grated, and repeatedly triturated in a mortar, with frequent edulcoration and pressing the pulp with the hands, there was obtained 111 gr. of white fecula, 20 of discoloured, 44 of pulp, and 825 of water and soluble matters.

The white fecula of the last experiment, when first separated, and only exposed to the sun for two days until it appeared quite dry, weighed 127 gr. but on being dried on an heated iron plate, it weighed 111 gr. Being then placed in a cellar for 12 hours it weighed 130 grains. Some fecula obtained from an early potatoe did not absorb quite 1-7th of its weight from the atmosphere.

The common process does not separate all the fecula from the pulp; for when the latter is dried, 1 oz. of it being boiled for a few minutes in 24 oz. of water, yielded a jelly, which with sugar and spices strongly resembled sago cooked in the same manner. This pulp therefore ought not to be flung away, nor used to feed pigs in its crude state, but should be boiled in a large quantity of water, in order to form it into a nutritious food.

The same pulp formed into little cakes while moist, and toasted with a little butter or oil, is an excellent substitute for coffee, and far superior to that vended under the name of English coffee.

Potatoes sliced, roasted, and then ground and mixed with 1-16th of the best Turkey coffee, is a very grateful beverage.

Vegetable fecula boiled with water seems to be the most economical method of fattening pigs; indeed the increase of nutriment by boiling farinaceous vegetables is so great, that it amply compensates for the extra trouble.

The best way of preparing potatoe-gruel for feeding cattle, is to grind or rather grate them by a mill into a large quantity of water, which should remain undisturbed for some hours, and then be decanted off. The whole sediment, including both the pulp and fecula, should then be mixed with the proper quantity of water, made to boil for a few minutes, and then cooled to a proper temperature for use.

If any prejudices exist, it may be mixed with barley meal, boiled potatoes, or ground lintseed cakes.

For the use of the table, the potatoes may be grated or rasped into a large quantity of water; the water left undisturbed for some hours, and then decanted off. To the sediment more water may be added, and, after standing an hour or two, again decanted off: this process being repeated until the water no longer acquires any colour, when the fecula and pulp being well mixed together, may be formed into cakes, and dried.

Half an ounce of this preparation will gelatinize a sufficient quantity of boiling water for a labouring man's breakfast. It may be sweetened with melasses or sugar, or cooked as soup, with an onion, pot-herbs, pepper and salt. When newly prepared, the raw flavour of the potatoe will sometimes predominate, which may be corrected by a little catsup, allspice, anchovy, or red herring. For the sick, it may be prepared with milk, sugar, and a little wine or spice. Infants have been wholly nourished for months, by it boiled in milk and water with a little sugar.

A larger proportion of the fecula will form a stiff jelly, which when acidulated with lemon-juice, or any vegetable acid, is an excellent remedy for the sore throat.

The preparation may be made more elegant, by separating the pulp, and using only the pure fecula, which is much superior to salep, sago, or arrow-root. A preparation of this kind has been

already in use under the name of sago powder. The fecula has also been strongly recommended as a substitute for salep.

The science of nutrition is at present in its infancy. The nutritive power of vegetables is generally supposed to be greatly increased by cooking. In the present tottering state of the doctrines of Lavoisier, it is doubtful whether water be a compound or simple body, but it is certainly an essential ingredient in the nutrition of animals as well as of vegetables.

Water, in its simple state, seems to act only mechanically, by giving a due consistency to the food, the superfluous quantity being conveyed off by the spleen. But when water is gelatinized by its chemical combination with fecula and heat, even the whole of its substance seems to become animalized by the action of the stomach; and therefore those processes for cooking vegetables which gelatinize the greatest quantity of water must afford the most nutriment. Hence, making potatoe-starch, as this fecula has long been called, is by far the most economical method of employing that root.

Common starch is unwholesome, as it has not only undergone a slight fermentation, but is also contaminated with a metallic oxide.

The fecula is equally nutritive from whatever plant it is extracted, and many indigenous vegetables contain it in abundance.

1000 grains of fresh-gathered horse-chesnuts, peeled and skinned, being rasped into water, yielded 200 gr. of fine white dry fecula, 32 of a yellowish fecula, 80 of dry pulp; the remaining 688 gr. being water, soluble mucilage, oil, and extractive matter.

1000 gr. of not quite ripe acorns peeled, and skinned, afforded 165 gr. of dry fecula of a brown colour, but equally nutritious as the white; 150 of dry pulp; the remaining 685 gr. being water, soluble mucilage, oil, and extractive matter.

1000 gr. of the fresh root of bryonia dioecia or mandrake, which is very large and thick, yielded 50 gr. of dry white fecula, 45 of discoloured fecula, 50 of dry pulp; the remaining 855 gr. being water, soluble mucilage, and extractive matter.

The root of arum maculatum, cuckow-pint, wake-robin (or lords and ladies), although one of the most acrimonious indigenous vegetables, is excellent if boiled, and still better if roasted. It makes beautiful vermicelli, or when dried it may be made into bread. It has been employed from time immemorial in the island of Portland for making starch, and affords the greatest quantity of fecula of any vegetable hitherto tried. 1000 gr. of the fresh root dug up early in May, yielded 254 gr. of very pure white dry fecula, 28 of dry pulp; the remaining 718 gr. being water, soluble mucilage, and extractive matter.

Observations.—We are apprehensive that the trouble and slop of thus procuring the fecula of potatoes, will prevent the intro-

duction of this process into domestic affairs, and especially as the subsequent use to be made of it is not agreeable to the habits of Englishmen. Wheaten bread forms such an agreeable food, that it is not probable that any substitute for it would be acceptable to those who have ever been accustomed to it.

The excise on starch would be also a considerable hinderance to the making of this fecula in the way of trade, as it would of course come into the market loaded with a very heavy duty.

The West India interest have endeavoured to introduce the use of coffee in lieu of tea; but great doubts may be entertained whether this will eventually prove of any benefit to them, as the same pressure of the times, which has led the generality to use coffee, now the price is low, will soon teach the retailers and consumers to adopt indigenous vegetables, for preparing it; and this measure will the more readily be adopted because the coffee of indigenous vegetables is fully equal to the West Indian.

On this subject, the third volume of the Retrospect, p. 164, may be consulted.

On the exhausting Machine of Dr. Thomas Stewart Traill. By Mr. Robert Bancks.—*Phil. Journ. No. 93.*

The application of the Torricellian vacuum instead of the air-pump, as proposed by Dr. Traill, is nearly similar in construction to one made ten years ago, for B. Clark, Esq.

Although this use of the Torricellian vacuum seems plausible in theory, yet it is scarcely possible to exclude the air by the simple process of filling with mercury, and permitting its descent, especially in his manner of putting on the cover after the recipient is filled with the mercury, from the repulsion between the metal and the glass: nor can the state of the vacuum be determined for want of a gauge.

In the beginning of 1808, an apparatus of this kind was made for J. G. Children, Esq. and which was his own contrivance. The recipient, however, was but of small capacity, and closed at top by a stopper pierced with two holes, to one of which a cock surmounted by a funnel was cemented, to the other a cock only. After the recipient had been filled as far as convenient by the open mouth, the stopper was put in, and the filling continued by means of the funnel, both cocks being open, until the mercury passed out at the second cock which communicated with the highest part of the recipient. The two cocks to the stopper were then shut, and the cock at the end of the iron tube to which the recipient was cemented at its lower opening, was opened, to permit the descent of the mercury.

A gauge being introduced, it seemed that so good a vacuum

cannot be obtained by this apparatus as by a good pump, for that will indicate an exhaustion to 1-40th of an inch even by a syphon gauge.

Even if this instrument could be made to supersede the use of pumps, many experiments that may be deemed of importance must be laid aside, as the apparatus could only be made in iron or steel, and would be more expensive than at present.

The editor of the Philosophical Journal remarks, that when giving Dr. Traill's instrument he did not think a perfect vacuum would be obtained by it; but the great utility of it, as well as of the others described by Mr. Bancks, consists in the rapid exhaustion of the recipient without any labour, which may be an object of importance on some occasions. The exhaustion, too, is probably considerable, though not complete.

Observations.—We agree with the editor of the Philosophical Journal in the remarks he makes on Mr. Bancks's communication to him, and think that an apparatus of this kind may be useful on several occasions, although it would be by no means proper to substitute it entirely for the air-pump.

Chemical Examination of a calcareous Stone called Thunder-pick. By Mr. J. Acton.—*Philosophical Journal, No.* 94.

The great eagerness with which newly discovered and rare minerals have been analysed has occasioned the more common ones to be in some measure neglected.

The stone now analysed is called thunder-pick, from its being supposed by the vulgar to fall from the clouds during thunder-storms. It weighs from 10 to 1000 grains, is conical, with a conical cavity at the base extending about 1-4th down. It varies from gray, brown, and brownish red, to nearly black, and is semi-transparent. The nearer it approaches to a red colour the greater is the transparency. This stone is generally found solitary, on turning up the ground by ploughing, or otherwise. When scratched, it has a strong smell of garlic or urine. The cross fracture is fibrous, the fibres diverging nearly from a common centre. The longitudinal fracture is glittering, with parallel streaks. It is moderately hard, and its specific gravity is 2.633.

It is infusible by the blowpipe, but loses its colour. It melts with difficulty into an enamel with phosphate of soda. It melts more readily with borate of soda into a semi-translucid white globe; but could be only partially melted into a white enamel with caustic soda.

Exposed to a moderate heat for $2\frac{1}{2}$ hours in a platina crucible, it lost only 4 per cent.; on increasing the heat for an hour, the

loss amounted to 42.90. Exposed to nearly a white heat for an hour in a porcelain crucible, it lost 45.90 per cent. The residues of these experiments, exposed to an intense white heat in a porcelain crucible for 4 hours, united in part with the crucible, which as well as the cover had begun to melt.

It is soluble in nitric acid, and carbonic acid gas is disengaged. From experiments it appears, that the thunder-pick contains 43.55 per cent. of carbonic acid gas, 53.95 of lime, 0.40 of the oxides of manganese and of iron, the remaining 2.10 per cent. being either water or a loss. No alumine could be discovered by the test of succinate of ammonia.

Observations.—The stone, as it is called, here described and analysed, is, in fact, the remains of an unknown marine animal, and is well known by the name of belemnite. A number of essays have been written upon it, as may be seen in the Systema Mineralogicum of Professor Wallerius.

Correction of a former Article.

We wish to take the earliest opportunity of correcting an oversight in an article contained in our 11th Number, vol. iii. p. 468; and we are the more anxious to lose no time in doing this, as it tended to implicate in a very unphilosophical want of candour one of our most illustrious cotemporaries. In the haste of much business it escaped us, that a formula of M. Laplace, which we then applied to the depression of the mercury in barometrical tubes in general, was expressly intended for *wide* tubes only: and we have therefore to recall, with much regret for our inadvertency, as much of our censure as depends on this mistake.

The Supplementary Number, to complete the fourth Volume, will be published on the 1st of March, price 2s. containing Index, Table of Contents, and Title, with the remainder of those papers that, agreeably to our plan, ought to be noticed in our present Volume.

No. XVIII. being the next quarterly Number, will be published May 1, 1809.

RETROSPECT

OF

PHILOSOPHICAL, MECHANICAL, CHEMICAL AND AGRICULTURAL DISCOVERIES.

SUPPLEMENT 1808.

NATURAL PHILOSOPHY, ARTS, AND MANUFACTURES.

New Theory of the Tides. By M. LAPLACE.—*Hist. des Mathemat. Tome IV.*

THE first object which M. Laplace undertakes, in his theory of the tides, is to establish the conditions of equilibrium for a point acted upon by any given number of forces in any given directions. He then considers the conditions of the equilibrium of fluids; and, regarding each of the molecules of which they are composed as being kept in a state of equilibrium by virtue of the forces which influence it, he determines the relation which subsists between the forces acting on the system when this condition is fulfilled; and applies it to the equilibrium of a homogeneous fluid mass surrounding a solid and fixed nucleus of any given figure. The forces which disturb the state of equilibrium are then taken into the account: these are the attraction of the sun and moon, and of the aqueous bed.

Proceeding upon the supposition that the earth is a spherical body without rotary motion, and the sea of uniform depth, he inquires into the nature of the oscillations that would be produced by the united influence of the sun and moon. In this inquiry M. Laplace limits himself to the supposition that the depth of the sea is only a function of the latitude. But even in this case the general integration of the differential equation, to which the investigation conducts, exceeds the powers of analysis; but a partial accomplishment of it is sufficient to prove satisfactorily, that the action of these two luminaries agitates the sea incessantly, and that it is sufficient to consider the oscillations which depend upon such action. And in the developement of the terms by

which they are produced, he divides them into three classes. The first depend only on the motions of the sun and moon in their respective orbits; they vary very slowly, and do not return in the same order until after a long interval of time. Those belonging to the second class depend chiefly on the rotary motion of the earth, and become the same again after an interval of a day, nearly. The terms of the third class depend upon an angle which is double the angular rotation of the earth, and therefore return in a similar manner after an interval of half a day. Hence result three different kinds of oscillations, corresponding to those respective periods.

Regarding the earth as a spheroid of revolution, and the depth of the sea as a function of the latitude, the oscillations of the first kind the author demonstrates to amount nearly to the same as if the sea were at every instant reduced to a state of equilibrium under the attracting luminary; as they are almost wholly destroyed by the resistance with which the sea necessarily meets in its motion.

The second species of oscillations involve in them the consideration of the earth's rotation, and the depth of the sea; and it is on these oscillations that the difference of the tides in the same day depends.

The third kind of oscillations are also calculated in the same manner, and upon the same principles. He concludes from the whole, that the depth of the sea only effects the oscillations of the second and third species, which reduces it to the supposition of being nearly uniform.

M. Laplace next approaches nearer to nature by establishing the motions of the sea, whatever be its depth, and the figure of the earth; and in this case he obtains the same result for the first species of oscillations. He then proposes to ascertain the laws of the depth of the sea, when the other two species of oscillations would become nothing all over the earth; and finds that this cannot be the case with the second kind, unless this depth be every where the same; nor with the third order, except the depth of the sea be infinite at the equator, and nothing at the poles. From which he infers, that there is no admissible law by which both kinds can be entirely destroyed together. The author afterwards applies the general hypothesis of an indeterminate depth, to obtain an approximate expression for the height to which the molecules of the sea are raised above its surface of equilibrium by the action of the sun and moon: and, notwithstanding the great number of natural phenomena which this general formula embraces, the influence of local causes introduces many modifications into the oscillations of this fluid mass, which render it insufficient for all observations. Hence the author concludes, that he must limit himself to the analysis of the general phenomena resulting from the attraction of the sun and moon, and to deducing, from his

observations on them, the data which are indispensable to complete, in every part, the theory of the flux and reflux of the sea.

In consequence of this limitation, he decomposes the forces which give motion to the molecules of the sea into three other forces; the first acting in the direction of the terrestrial radius; the second perpendicular to this radius, and in the plane of the meridian; and the third perpendicular to that plane. And supposing the sun to move uniformly in the plane of the equator, and to be always at the same distance from the centre of the earth, he establishes this general principle, that the state of a system of bodies, in which the initial conditions of motion have disappeared in consequence of the resistance opposed to them, is periodical, as well as the forces by which they are actuated; and as these forces have been found to return to the same state after the interval of half a day, he concludes, that there must be a flux and reflux of the sea in that interval. From this inquiry he also deduces an expression for the height of the sea occasioned by this influence, in which are included two arbitrary constant quantities, the one of them depending upon the magnitude of full tide at the port under consideration, and the other upon the hour of such tide.

The action of the moon is next considered, under a similar supposition to the sun, with respect to its uniform distance from the earth and the plane of its motion, and the result is a flux and reflux, similar to that produced by the action of the sun: and having obtained an expression for the elevation of the sea under the influence of this cause, he combines it with the former, and thus deduces an expression for the total height of the tide; which necessarily includes four arbitrary constant quantities. The elevation is the greatest when the lunar and solar tides coincide; and least when the high tide of the body which produces the greatest effect coincides with the low tide of the other. This affords an easy means of ascertaining whether the lunar or solar action is the greater; and which is well known to be the former.

The author then considers the case, in which the sun and moon, always moving in the plane of the equator, but subject to inequalities in their motions and distances; and lastly he passes to the case actually occurring in nature, in which attention must be paid to the declination of these luminaries. He shews that this general case, as well as the preceding, may be applied to that of several other bodies moving constantly in the plane of the equator, but at different distances from the centre of the earth, and with different velocities in their orbits: and from a combination of these partial actions he concludes, that in the system of nature, in which these luminaries move in orbits inclined to the equator, the elevation of the tide is owing to the attraction of both the sun and the moon.

Notwithstanding the generality of this analysis, it supposes that

the sea entirely covers the terrestrial spheroid, that its depth is uniform, and that it experiences no resistance from the spheroid it encloses. The author, therefore, gives a demonstration independent of these hypotheses; and proves that the motion of the earth round its centre of gravity is the same as it would be if the sea formed with it one solid mass. He then extends this demonstration to the case in which the earth is of any given form.

After having established this excellent theorem, M. Laplace examines whether the trade-winds do not alter the rotary motion of the earth, by striking against the continents and mountains they meet with; but finds their effects counterbalanced by the other motions of the atmosphere, which take place beyond the tropics by virtue of the same cause. He then applies this reasoning to earthquakes, torrents, and generally to whatever is likely to agitate the earth in its interior and at its surface; and he concludes, that these causes do not at all distusb the rotary motion of the earth, which can only be altered by displacing its parts; but this effect, to be sensible, would argue great changes in its internal constitution.

Observations.—Among the phenomena which the system of the universe presents to our observation, there is perhaps none of more importance than that of the tides, the explanation of which was hid from the ancients in impenetrable obscurity; and even the attempts of those who have endeavoured to explain it in much later times bear evident marks of wild conjecture. What was known on the subject prior to the time of the great NEWTON, who dispelled the impending darkness, and solved the problem upon the principle of universal gravity, chiefly consisted of an unconnected series of observations, many of which were made or collected by *Pytheas*, of Marseilles, as early as the close of the fourth century before the Christian era; except two dissertations by Wallis and Flamstead, published in the Philosophical Transactions.

Newton's solution of this important problem was greatly simplified, by his supposing the waters to be brought to a state of equilibrium by the three forces of gravity inherent in the earth, the sun, and the moon; and that they assumed at each instant the figure of an aqueous spheroid, in consequence of the influence of the action of these forces: and the result of this hypothesis agreed in many respects with observation. He, however, had recourse to the rotary motion of the earth, in order to account for the retardation of the tides; but his reasonings on this point were not altogether satisfactory; and it appeared that he had not so completely investigated the whole subject, but there was still room for considerable improvements. It was, therefore, proposed as a prize question, by the Academy of Sciences, in 1740. This circumstance occasioned the three learned and ingenious dis-

sertations of Daniel Bernoulli, Euler, and Maclaurin. These, however, were founded upon the same principles and supposition of equilibration as the original solution of Newton. But this state of equilibrium can never take place in nature; as the rotary motion of the earth never suffers this aqueous spheroid to be actually formed. But the constant tendency of the waters to this figure, occasioned by the three attractions above mentioned, produces a continual oscillation in the ocean, which prevents it from ever attaining a state of equilibrium. To determine the nature of these oscillations constitutes a problem which was superior to the powers of analysis and the knowledge of the motion of fluids at the time when the preceding solutions were effected: and, aided by all the improvements that have since been made in these two grand branches of science, M. Laplace was the first person who felt himself qualified to undertake the investigation of a problem which he denominates the most difficult in *La Mecanique Céleste*. In the years 1775, 1779, and 1790, he transmitted memoirs on this subject to the Academy of Sciences, and he has since collected and extended these in the fourth book of his *Mecanique Céleste*. Laplace's investigations enable us, in many cases, to state the individual fact in a direct manner, and without considering it as a modification of some more general circumstance: such are the height of the tides in different latitudes, and in different directions of the attracting forces; the difference between two consecutive tides; and the difference between the passage of the sun and moon over the meridian, and the subsequent time of high water; which are all explained in a more direct manner by his theory than by any other that preceded it. Another circumstance which this author has ascertained by his theory is the permanent equilibrium of the sea. His inquiry respecting this subject was, whether any motion communicated to a fluid mass surrounding a solid nucleus would not cause its vibrations to increase to such a degree as to overflow the highest parts of the land, and thus serve to account for the various appearances in natural history, which are evidently of a submarine nature. The result of this inquiry was, that these vibrations can never increase to such a degree, unless the mean density of the earth be less than that of the sea; and as this is known not to be the case, an explanation of these appearances must be derived from other sources than this supposed instability of equilibrium. This theory also affords the most irrefragable confirmation of the theory of universal gravity; as the genuine results of both, when deduced with a due regard to concomitant circumstances, and independent of any hypothetical simplification, maintain an exact coincidence. The mode of investigation in this theory likewise affords a good model for the imitation of those who are desirous of becoming acquainted with the laws by which the vast economy of nature is uniformly regulated.

There is, however, some reason to doubt whether Laplace has yet explained all the variety of phenomena connected with this subject, with all the precision of which they are susceptible. The whole application of his theory depends upon the data which furnish the arbitrary constant quantities contained in his resulting expressions; and which were drawn from observations made in the French and Spanish ports, none of which were very different in latitude. And it is not improbable but this circumstance has induced him to simplify the data upon which the practical utility of his theory depends too much. M. Laplace says, that the obstructions are such as to destroy all motion very soon after the force which caused it has ceased to act; and therefore he infers the equation of superior and inferior tides of the same day, from the supposition that the sea is nearly of a uniform depth; a supposition which is certainly exceptionable. Daily experience manifests, that the state of the waters is affected by the continued action of forces that have ceased many hours before; it is, therefore, impossible, from this cause alone, that any two tides, immediately succeeding each other, can be very unequal: and that all primitive motions of the ocean have long been annihilated, is another of his positions, the correctness of which has been doubted. He also supposes that the tides, which are observed in exposed harbours, are almost wholly produced by the transmission of the effect from the main ocean, in about a day and a half, instead of regarding it as the effect of the immediate elevation or depression of the ocean in its vicinity, which is more agreeable to observation.

As Laplace is supposed to have erred in some points with respect to matters of fact, and his theory is rather of a complex nature, attempts have been made, in this country, to substitute for it one that was more simple: and Dr. Young observes (*Nat. Phil.* vol. i. page 578), that if the waters were capable of assuming instantly such a form as the equilibrium would require, the summit of a spheroid equally elevated would still be directed towards the moon, notwithstanding the earth's rotation. This may be called the primitive tide of the ocean; but, on account of the perpetual change of place, which is required for the accommodation of the surface to a similar position with respect to the moon, as the earth revolves, the form must be materially different from that of such a spheroid of equilibrium. The force employed in producing this accommodation may be estimated by considering the actual surface of the sea as that of a wave moving on the spheroid of equilibrium, and producing in the water a sufficient velocity to preserve the actual form. We may deduce, from this mode of considering the subject, a theory of the tides, which appears to be more simple and satisfactory than any which has yet been published: and by comparing the tides of narrower seas and lakes with the

motions of pendulums suspended on vibrating centres, we may extend the theory to all possible cases.

For the results of Dr. Young's investigations, upon these principles, we refer the reader to his Nat. Phil. vol. ii. p. 343 and 344.

Improvement on Wheel-carriages. By Mr. P. Andrews.—*Repertory of Arts, No. 77, Second Series.*

The first of these improvements relates to a ground-plan of a waggon, or other four-wheeled carriage, consisting of a pole, two splinter-bars, the two axle-trees, and the wheels. Both the axle-trees revolve on centre bolts, in the same manner as the fore axle-tree does in all four-wheeled carriages, and they are connected together by diagonal chains fixed to each of their extremities, in order to take off all strain or force from the centre bolts. The chains are placed the whole width of the axle-trees above each other, to avoid friction. The wheels are to be cylindrical, and may be made of any height, and either to pass under the waggon, or to lock into a nook in the side. If the fore-wheels pass under the body of the waggon, their axle-tree is to be shorter by the breadth of the fellies than the hind axle-tree; but if they lock into the side of the waggon, the length of the fore axle-tree is to exceed that of the hind one by the same breadth; by which means the wheels cover twice their own breadth on the fellies, and operate as rollers to the roads.

The advantages which the author of these improvements says are to be derived from carriages of this construction are, that the whole fabric of the waggon may be made much lighter; and, from the position and effect of the chains, the centre of gravity, of motion, and of draught, are all in the same point, consequently (if the wheels are of the same height, which they should be) the line of draught will be horizontal, and, in every possible position, a straight line; therefore, such a carriage cannot be overturned unless it be drawn on any bank, &c. which exceeds 45 degrees of elevation; and it will run much lighter, and with less force, than any other carriage. It will describe a circle round a point, therefore it may be turned round on its own length of ground, and in a sharper angle than any other carriage can. Either end may be used as the fore end at pleasure, by merely removing the pole or shafts, by which all obstructions and stoppages are avoided.

The second part of this paper relates to the invention of an expanding axle-tree, adapted to various purposes in agriculture. This axle-tree is fixed to two alternate sides of a square frame, near their extremities, and in such a manner, that its centre and the two angular points of the frame are in the same straight line.

The sides of this square frame are of a proper length for admitting of an angular expansion to the required width, and are crossed by two bars, which intersect each other in its centre, and are sufficiently extended beyond its corresponding sides to be connected with a harrow, rake, or drill, by means of two joints, which move both ways, so that when the carriage is in use, it not only expands with the carriage, but will let its ends fall downwards, so as completely to embrace any ridge of land however convex; also, when the carriage is contracted, those arms and joints will cause and permit the harrow to contract at the same time. These bars are fixed to the frame, and the sides of the frame to each other, by bolts, so that every point of contact has a free motion. A chain or rope is fixed to that angle of the frame which is next the harrow, &c. and extends beneath the axle-tree to the opposite angle, having a ring attached to its loose end. There is also another ring fixed to this latter angle of the frame; and by fixing the horse to the former or the latter of these rings, the carriage will be progressively expanded or contracted for use, and kept in that state.

By this frame, &c. the author observes that the carriage may be expanded or contracted to answer any road, or to cultivate any given width of ground at once going over. The driver is to ride, and the horse and wheels to go in the furrows; and thus do much more work and in a better manner, with less injury to the soil and grain than by any method now in use. The invention may also be applied to a one-horse chaise, taxed-cart, &c. where the roads are bad, as such chaise, &c. could contract or expand so as to run within or without the old ruts; for which purpose the frame might be made circular, which would be a more pleasing form, and as light as possible.

Observations.—We are by no means persuaded that the former of these inventions possesses all the advantages which Mr. Andrews supposes it does: the latter is certainly ingenious, and deserves recommendation.

Description of a Machine for beating out Hemp-seeds and Flax-seeds; invented by Mr. Ezekiel Cleall, *of West-Coker, Somersetshire.—Trans. Soc. Arts, Vol. XXV.*

This machine consists of a strong horizontal frame, near one end of which are inserted two upright pieces of strong wood, which support an axis, containing four equal arms. To the extremity of each of these arms are united two flails, nearly in the form of the letter V, by means of a pin; about which they revolve to a certain extent. Near the other end of the horizontal frame are

other two shorter pieces of upright wood, which, in conjunction with the two former, support two long levers upon which the table or board, whereon the hemp or flax is to be placed, rests.

When the machine is used, the hemp is to be laid on the table, and moved about in different directions by the person who holds it, while another person puts the machine in motion by means of a winch or handle fixed to the axis, which causes each of the flails to descend on the hemp in succession as the axis moves round. When the machine is used for beating out flax-seeds, a heavy piece of wood is to be fixed into each arm, instead of the two flails, as they require more force to separate them from the plant than hemp-seeds do.

Mr. Cleall says that the machine will thrash, in one day, as much hemp as grows on an acre of land, and other crops in proportion; and the work is done with less than half the expense of thrashing in the usual way. And a testimonial, signed by five gentlemen of West-Coker, certifies that the seeds thrashed by this machine are not so much bruised or injured as by the old or common way, and the hemp and flax are preserved from many injuries which they suffer from the former method.

Observations.—The simplicity and utility of this machine fully entitle the inventor of it to the reward that was bestowed upon him by the Society of Arts.

Description of a Machine for breaking Hemp; with Observations on the Culture of Hemp in Canada. By William Bond, *Esq. of Canada.—Trans. Soc. Arts, Vol. XXV.*

In order to render this laborious employment more easy and expeditious, Mr. Bond makes use of a water-wheel in his machine. On the axis of this wheel is fixed a trunnion, consisting of four equidistant lifters, each of which in succession raises a lever fixed on an axis; the other extremity of this lever is connected by means of a chain, with one end of a second lever, the other end of which is fixed in the frame of the upper part of this double brake, which turns on two pivots. As each lifter raises the lever, the upper part of the brake is raised, and when it has passed it, this part of the brake is allowed to fall upon the hemp which is placed on the lower part, and by its weight and teeth intersecting the teeth of the lower brake, the woody parts of the hemp are by repeated strokes separated from the filaments or fibres of the hemp proper for use. A table, on which the woody parts of the hemp fall, is fixed below the brake to the four legs or supporters of the frame, and serves to give it a greater degree of stability.

Mr. Bond observes that such a simple piece of machinery would not cost more than 70 or 80 dollars, as little iron would be wanted,

and timber is had in Canada for nothing; and when in motion it would employ four breakers and two servers, who would do as much good work as fifteen or sixteen persons could possibly perform in the old way, and that without much bodily labour. He also adds, that mills for breaking hemp, on the very same principle as that of the saw-mill, with only an additional crank and rather a larger sweep, would be of great utility in a neighbourhood of a large growth of hemp, and would not cost more than a common saw-mill; as the brakes of the frame continue in motion the same as that of a saw-mill, twenty men might be employed, who would do as much work as fifty or sixty could in the old way.

Mr. B.'s observations on the culture of hemp relate chiefly to the fitness of the soil for the growth of this plant, the obstacles to be overcome in its cultivation, and the advantages that would result to our own country from this cultivation being carried on upon a large scale.

Observations.—This paper gives no direction respecting the best figure for the lifters, but, from the plate with which it is accompanied, they appear to consist of a judicious union of epicycloidal curves.

Description of a new Compensation-Pendulum. By Mr. H. Ward, *of Blandford, Dorsetshire.—Trans. Soc. Arts, Vol. XXV.*

Mr. Ward's compensation-pendulum consists of two flat rods or bars of iron, about $\frac{1}{8}$th of an inch in thickness, with a bar of zinc interposed between them, which is nearly one quarter of an inch think. One of the iron bars has a shoulder at each end, turned at right angles, and by means of one of these shoulders it rests upon the upper end of the zinc bar; the other has only one similar shoulder near its upper end: the whole is fixed together by means of three screws, which pass through oblong holes in the zinc and one of the iron bars, and fasten in the other; and the compensation of the whole is adjusted by means of a fourth screw. In the pendulum that was sent to the Society, the length of the zinc bar, hammered three quarters of an inch per foot, was 22 inches, and the length of the iron bars together was 61.2 inches.

Mr. Ward says the advantages of this pendulum are, 1st, That, from its simplicity, it will never fail to have the desired effect. 2dly, That no extraordinary care is required in executing it. 3dly, That the compensation may be increased or diminished with the greatest ease, without stopping the clock more than a minute, by making fast one of the screws that keep the rods together, while the adjusting screw is removed, taking care to loosen it again afterwards. And, 4thly, That it can be made for less expense than any other compensation-pendulum hitherto published.

This paper is also accompanied by a register of the going of two clocks furnished with pendulums of this kind, sent to the Society by Mr. W. since he transmitted to them his pendulum.

Observations.—We agree with the inventor of this compensation-pendulum, that the objections against zinc as a fit substance for this kind of pendulums, are not so forcible as they have been commonly represented: and we are ready to acknowledge that the pendulum now proposed, is nearly as simple and ingenious as any we have seen, consistent with the general plan Mr. Ward has adopted. But from an attentive consideration of the advantages and disadvantages of the different modes of construction, as they apply to compensation, we are inclined to think that the greatest benefit will result from the improvement of tubular pendulums, such as were proposed about half a century ago by Mr. Finney, afterwards by Mr. Chandler, and very recently revived with important modifications by Mr. Troughton. Those of our readers to whom the improvement of chronometers of different kinds is interesting, may read with advantage an account of the progressive improvements of time-keepers, given in our second volume.

Description of improved Tram-plates for Carriages on Rail-roads. By Mr. Charles Le Caan, *of Llanelly, Wales.—Trans. Soc. Arts, Vol. XXV.*

Mr. Le Caan's tram-plates are fastened together by means of a tenon and mortise, each having a correspondent bevel, so that the head of each plate confines the end of the next succeeding one. These plates rest upon stone blocks or sleepers, placed at the distance of three feet from each other, into which they are fixed by means of perpendicular or beveled plugs cast in the head of each plate; those in the stop plates only being of the former kind. The blocks or sleepers on which the plates rest, should by no means weigh less than 120 lbs. each, and in some kinds of ground even heavier than this. Besides the advantage of having a more perfect rail-road, and several others, Mr. Le Caan estimates a saving of about 50*l.* per mile, by adopting this mode of construction.

Observations.—Mr. Le Caan's method of fixing the plates, in which his principal improvement consists, appears to be well calculated to remove several of the disadvantages attending this operation, in the most approved constructions previously in use.

The plates used in the Surry rail-way have a counter-sunk rectangular notch in each end; and when joined together endways, these notches form a square hole, through which an iron spike, having its head fitted to the counter-sunk part, is driven

into an oak plug inserted for that purpose in the stones upon which the ends of the plates rest; and thus confines their adjoining extremities in the proper places. In Mr. Woodhouse's patent for a new method of forming a cast-iron rail, described in the third volume of the Repertory of Arts, Second Series, the plates are to be fastened upon similar bearings by means of wrought-iron screws or cutter-bolts. And we are persuaded that, after attentively comparing these three different methods together, the reader will feel no hesitation in preferring, with us, that which is the subject of the present paper. We have some recollection, however, of having seen Mr. Le Caan's plan, or something very similar to it, detailed in a book published about ten years back, by Mr. Curr, of Sheffield, entitled, "The Coal-viewer and Engine-builder's practical Companion." A very ingenious method of forming an iron rail-way, by means of elliptic rails, was invented by Mr. Benjamin Wyatt, and is described at page 285 of vol. iii. of the Repertory, *Second Series.*

Description of an improved Ship Stove. By Mr. Joseph Collier, *of Crown Street, Soho, London.—Trans. Soc. Arts, Vol. XXV.*

This stove consists of a circular body placed upon a stand, which contains an ash-dish, that may be drawn out at pleasure. A sliding plate is fixed to the stove, by which the opening in front may be closed in any degree; and to the edge of this plate there is another attached, which acts as a blower, to cause the fire to burn more briskly, or which slides down to shut it up. The expense of one of these stoves of twelve inches diameter, is about eight pounds.

Observations.—We are not aware of any thing in the construction of this stove which might not have been as well done by any other person as by Mr. Collier. Neither have we discovered any thing during our examination of it, which deserves either peculiar censure or commendation.

Description of a Mortar for preparing mercurial Ointment. By Mr. James Phœnix.—*Repert. of Arts, No. 77, Sec. Series.*

The cavity of this mortar somewhat resembles an inverted paraboloid with a pointed vertex, into which the mercury is to be put: the pestle is nearly of a similar shape, and is kept in a vertical position by its handle, or rather axis, passing through a frame fixed to the mortar. The pestle is worked by means of an endless screw, which turns a wheel upon its axis, being itself supported

horizontally by the above-mentioned frame, and put in motion by a winch. To the upper extremity of the pestle's axis, two cross bars of iron are attached, having their ends loaded with lead, in order to increase the friction by which the mercury becomes oxyded.

Observations.—The object which Mr. Phœnix wishes to obtain by this contrivance is a rapid motion; but for the attainment of it, he has certainly adopted very inadequate means. If he had substituted a beveled wheel instead of the screw, and a pinion of much less diameter on the axis of the pestle or grinder, he would have insured a greater degree of success. Surely it would not be mispent time for some gentlemen to consider the *nature* of machines before they publish the manner of their application.

REVIEW OF SPECIFICATIONS OF PATENTS,

PUBLISHED IN THE REPERTORY OF ARTS, MANUFACTURES, &c.

Mr. Benjamin Cook's *Patent for a Method of making Barrels for Fowling-pieces, Muskets, Pistols, and other similar Fire-arms, and Ramrods for the same. Dated March* 1808.—*Repertory of Arts, No. 79, Second Series.*

After pieces of either simple or compound metal are prepared in the usual manner, by cutting them into proper lengths, and boring or drilling out the core a part of the required length instead of the whole, or turning plates of metal and welding them, Mr. Cook causes these carcases to pass through either holes in plates graduated one size below another, or through grooved rollers, until they have attained the length, size, form, and thickness required.

Another method of Mr. Cook's is, to force a round thin plate of metal through a hole of less diameter than the plate, which causes it to assume a concave form, and by passing it through a continued succession of smaller holes, it is changed into a tube of the length and size required. In some cases it is necessary to keep a bar within the barrels during these operations, especially when the bore is required to be of any form but circular; and as the barrel lengthens, it takes the form of the bar within it.

The advantages which fire-arms possess, that are made by this method, over those which are made in the common way, as pointed out by the patentee, are, that the sides of the barrels will be of an equal thickness throughout, and their surfaces free from any irregularity; that there can be few or no unsound places in them; that they will not be liable to burst, as the process compresses the metal so much, and the frequency of annealing imparts to it the nature of wire. They may also be made about one third lighter than by the usual method; and as it is hardly possible

that the barrel can be thicker in one place than another, they will act with more precision and greater effect.

The ramrods are either drawn like wire, or passed through plates or grooved rollers, and a thick end left from which the head is formed; or they are made of the same size throughout, and the head fastened on afterwards.

Observations.—Some of the properties which the barrels made by this method are said to possess, certainly add much to their value; but that of being of equal thickness throughout must be regarded as a great defect; for as the expansive force of the powder will be much the greatest towards the breech, that part should undoubtedly be the strongest, in proportion to the force exerted upon it. Nor do we believe that this method of forming them will increase the lateral strength of the metal so much as Mr. C. supposes. Metallic pipes for a variety of other uses besides those set forth in this specification, might certainly be manufactured with advantage by the same process.

Mr. William Bell's *Patent for an Improvement in making Pipes or Pumps for conducting Water and other Liquids. Dated April* 1808.—*Repertory of Arts, No. 79, Second Series.*

In the beginning of this specification Mr. Bell says, that the materials of which pipes for conducting water and other liquids are usually made, as wood and various kinds of metal, have been justly objected to on account of the pernicious qualities they are liable to impart to the fluid conveyed through them. The object of his patent is, therefore, to remove these objections by the substitution of tubes made of porcelain pottery, and various compositions which are vitrifiable and not liable to corrosion or decay. These tubes are to be so formed at the ends that they may fit into each other, and be made air or water tight by means of cement; and thus, by adding any number of these short tubes, the pipe may be formed to any extent required. In order to give the pipe thus formed a sufficient degree of firmness, and preserve it from external injury, it is to be enclosed in a case, which Mr. Bell recommends to be made of cast iron, on account of its strength and durability.

The patentee likewise observes, that tubes may be made of certain compound metals, which are less corrosive than real metals, and also of wood prepared for durability by boiling, and burning or charring it: this too he claims as part of his patent.

Observations.—However just the objections against wood and most metals may be, they lose their force when applied to iron. Fourcroy, in his Elements of Chemistry, says, that this is the only metal, the effects of which are not to be feared; and he has

enumerated many instances in which its effects on the animal economy are highly beneficial. Therefore, the enclosure of pottery tubes within those of iron would be adding greatly to the expense, without obtaining any adequate utility. Besides which, the liquid kept in vessels of common pottery, or such as are badly baked, enters their pores, where it undergoes a decomposition and produces sulphurated hydrogen, the effects of which are highly pernicious. See a paper on this subject in our second volume, page 157.

Mr. JOHN WATSON's *Patent for Improvements in the Art of Soap-making, by which the Article is in several Respects ameliorated.—Repertory of Arts, No. 78, Second Series.*

INSTEAD of putting the new-formed soap into the usual moulds, that it may harden for sale, Mr. Watson re-dissolves it in water, and again separates it by means of common salt: and he repeats this process several times, so as to render the soap more perfect by separating any uncombined alkali or oil that might have existed in it.

The same process of successive solutions and separations may also be performed upon soap already manufactured.

The purified soap may also be dissolved in about half its weight of alkohol or ardent spirits, and after it has been moderately boiled it may be poured into moulds, and the soap dried by a proper temperature, so as to produce a beautiful degree of transparency.

When a less degree of firmness is required, sugar or saccharine matter may be added to the mixture.

Observations.—Those luxurious persons, whose critical eye reposes with pleasure upon the elegant appearance of things in preference to their intrinsic goodness, will doubtless be highly pleased with these supposed improvements; but the presence of some uncombined alkali doubtless increases the cleansing properties of the common soaps, and therefore the entire separation of it must be in some degree injurious.

Mr. EDWARD MOORE NOBLE's *Patent for a new Method of making Carbonate of Lead, commonly called white Lead.—Repertory of Arts, No. 76, Second Series.*

THIS method consists in keeping lead, or an oxide of it, half immersed in acetous acid, or in a solution of acetate of lead, in an atmosphere highly charged with carbonic acid gas; by introducing that gas within the vessels, and occasionally agitating the lead, or its oxide, in order to renew the moistened surface. If the carbonate of lead is intended to be mixed with oil, it is dried after it

has been separated from the uncorroded parts; and sometimes the carbonate is washed with water previously to being dried.

Observations.—We do not consider this method as any great improvement in the manufacture of white lead, as we conceive that the action of the acetous acid is little or nothing promoted by the carbonic acid gas. Nor can we conceive any other reason that Mr. Noble could have to take out this patent, but a desire to add the magic word "patent" to white lead, and thus, by playing on the well-known predilection of the public for patent manufactures, acquire an increased sale for his article.

CHEMISTRY AND MINERALOGY.

Apparatus for the Decomposition of the Alkalies under Naphtha, by Galvanism. By Mr. W. H. PEPYS.—*Phil. Mag. No.* 124.

To a bottle without a bottom, a glass stopper is accurately ground. This stopper is perforated through its axis, and a wire that is passed through this perforation serves to connect a plate of platina lying on the internal surface of the stopper with a plate of copper that serves for a foot to the inverted vessel, and is brought into contact with the positive end of the galvanic trough.

The alkali, slightly moistened, is placed on the platina plate; the inverted bottle is filled with naphtha, and covered with a wooden cover, through which a platina wire, with a disc of the same metal at the lower end, is allowed to slide. This wire communicates with the negative end of the trough, and on the button being brought into contact with the alkali, the latter is decomposed; the produced metal sometimes floats, but the greatest portion is found imbedded in the alkali.

The gases evolved during the process may be collected by a slight variation of the apparatus.

Experiments with a very powerful Furnace.—*Phil. Mag. No.* 124.

THIS furnace was buried in powder of charcoal, in order to prevent the escape of the heat; it opened in the middle into a cupel; the fuel was supplied through an opening at the top, and the combustion kept up by oxygen gas impelled into the furnace by means of forcing pumps.

A seven shilling piece of gold coin disappeared in ten minutes; platina was melted; and charcoal exposed to its heat, under sand, for a quarter of an hour, became so hard as to resist the knife.

Observations.—We have some doubts respecting the credence to be given to these anonymous experiments.

On Ignition by compressed Air. *By* J. A. De Luc.—*Phil. Journ. No. 93.*

In the question proposed on this subject, in Phil. Journ. No. 89 (see p. 282), the ignition is supposed to be the effect of the compression of the air itself. But the air does not arrive at any great density in the instrument, for otherwise the piston would recoil to its former position, and it could not reach almost the bottom of the syringe, which is absolutely necessary.

It is therefore the condensation of the immediate cause of heat, or fire, that produces the ignition, in the same manner as when iron is very rapidly hammered. Fire may be compressed or rarefied like air by mechanical means; the only difference being, that some vessels may be made air-tight, and of course the density of the air may be altered as slowly as is convenient; but no vessels being fire-tight, the condensation of it requires a rapid motion, or otherwise the condensed fire escapes.

Account of a simple Improvement in the common Still. *By Mr.* J. Acton.—*Phil. Journ. No. 95.*

When a worm-tub of 36 gallons was connected, as usual, with a still of nine gallons, the water soon became so hot as to require changing. But a horizontal pewter pipe, rather more than three feet long, two inches in diameter at the end next the still-head, and gradually tapering to 3-4ths of an inch at the other, being made the means of communication between the still and the worm, and this pipe passing through the middle of a trough 3 feet long, 12 inches deep, and 15 inches wide, the distillation could be carried on for any length of time without raising the temperature of the water in the worm-tub a single degree, as the heat is accumulated in the trough, and when elevated to about 140 or 150°, passes off by evaporation.

Observation.—This additional apparatus is simple, and is probably very effective; it must therefore be advantageous where water is scarce, or troublesome to procure.

On the Calcination of Potash with carbonaceous Matters. *By Mr.* James Woodhouse.—*Phil. Journ. No. 94.*

Half a pound of soot mixed with two ounces of pearl-ashes was exposed to a very intense heat, in a covered crucible, for two

hours. When water was added to it, after being cooled and poured out on a dish, it caught fire, and emitted ammoniacal gas.

A similar result took place when charcoal was employed instead of soot.

Is the azote, which forms one of the constituents of ammonia, also one of the component parts of potash?

Nascent hydrogen sometimes, indeed, combines with the azotic part of the atmosphere, and forms ammoniacal gas: but when the flames of the mixture of potash and carbone were extinguished by water, and it was placed under a bell-glass containing common air, it absorbs the oxygen, and leaves the azote. No carbonic acid is formed.

On rendering Sugar unfit for the Food of Man, or for Distillation, in order that the Duty may be taken off, and the Sugar employed as Food for Cattle. By Mr. Samuel Parkes.—*Phil. Mag. No.* 124.

As the present price of sugar, including the duty, renders it impossible to use it in feeding cattle, the West India committee applied to Mr. Parkes to discover some substances which might be so united with sugar as to prevent its being afterwards used for common purposes, and at the same time not to injure its nutritive qualities, in order that a drawback of the duty might be allowed on all sugar employed in feeding cattle.

If sugar were mixed with ground corn, barley-meal, or other farinaceous matter, which might be done in the presence of an excise officer. it might be washed out by water, and the sugar brought again into the market.

Lime, even in small quantities, renders sugar incapable of fermentation; but as lime is very sparingly soluble in water, it might answer the best to mix lime in powder with the sugar.

The solution of sugar in water will keep for a long time without being altered, if the sugar be pure; but the addition of mucilaginous or farinaceous matters speedily induces the vinous fermentation.

Few bodies combine chemically with sugar.

Ten grains of a very strong ley of caustic potash, mixed with 112 grains of good brown sugar, gave it a disagreeable urinous taste. This would cost 2*s*. 9*d*. or 3*s*. per cwt. of sugar. By adding 3 grains of sulphuric acid, diluted with a little water, the usual flavour of the sugar was restored. Although this would cost only 1*s* per cwt., yet as sulphate of potash would be left mixed with the sugar, it could not be separated without a great expense.

Four grains of palm-oil gave 112 of sugar a full taste of the

oil, but the flavour is so grateful, that cattle would probably eat it greedily. The cost of this would be 2*s.* 6*d.* per cwt.

A single drop of oil of hartshorn effectually spoiled the taste of 224 grains of sugar: but it may be doubted whether even cattle would eat it at first; they might however be brought to eat it. The cost would be only 1*d.* per cwt.

Cattle eat rancid fish-oil with avidity: such oil, and particularly the dregs of oil commonly called oil-foot, might be poured on sugar in the presence of an excise officer. Linseed-oil, as being more fluid, might also be poured into the hogsheads at the cane-holes, and would spread itself through the whole mass. This sugar could never be afterwards used for domestic purposes, and would be incapable of fermentation.

The sulphurets of the fixed alkalies convert sugar into a mucilage not unlike gum, which is probably nutritious.

Fourteen grains of dry sulphuret of potash, mixed with 112 of sugar, rendered it clammy, and took away all its flavour. If the sulphuret were to be manufactured for this purpose, it would cost 1*s.* per lb.; but some coarse sulphurets might be had cheap enough.

Two drops of tincture of galls being added to 112 grains of sugar, which had been previously moistened, and afterwards impregnated with two drops of a solution of sulphate of iron, caused it to become quite black, and to taste strongly of iron. It would cost 1*s.* per cwt. to blacken sugar in this way, unless oak-bark, or some other substance, were employed instead of the galls. If the gallic acid were separated by means of potash, the sugar might indeed be used for the still, but the least error in the quantity of the potash would render the sugar incapable of fermentation, and the spirit would probably be contaminated with the iron.

Ten grains of sulphuric acid, diluted with a little water, blackened 112 grains of sugar, and rendered it very sour. This would cost about 3*s.* or 3*s.* 6*d.* per cwt. A less quantity of acid might suffice, so as to render the sourness imperceptible when mixed with a large proportion of other food.

Ten grains of alum gave an astringent taste to 112 of sugar, and took away its sweetness. This would cost 2*s.* 3*d.* per cwt. Nitrate or muriate of barytes would separate the sulphuric acid, and decompose the alum, but those salts are poisonous.

Twenty grains of common salt render 112 of sugar unfit for domestic use. If Government would allow the pickings of the pans free of duty, which might be had at 5*s.* or 10*s.* per ton, this would be the most suitable and economical article, as cattle are very fond of salt. The sugar and the salt might be mixed by a mill, like that employed for making mortar.

If Government would not allow the waste salt duty free, sugar might be dissolved in sea-water, in presence of an excise officer, and there would be no danger of its being again taken for common

consumption. Thirty pounds of sea-water contain about one of salt, and would dissolve about 30 of sugar.

Some great graziers imagined that 1-6th of salt might be advantageously added to sugar; but in order to secure the revenue, one part of salt, and one of train-oil, might be mixed with 10 of sugar. Indeed less than 5 per cent. of train-oil would effectually prevent sugar being used for domestic purposes.

The quantity of saltpetre necessary to alter the flavour of sugar would cost too much for the farmer.

A quarter of a grain of assafœtida rendered 112 grains of sugar unfit for common use; whether cattle would eat it when mixed with other food, requires trial. It would cost only 4*d.* per cwt.

Several other substances might be tried, as rape-oil, whale-oil, foot-oil, horse-turpentine, coal-tar, common tar, the gall of animals, blood, wood-ashes, soap-ley, madder, wormwood, gentian, quassia, and the residuum obtained from oil of vitriol makers, called sulphur-ashes. Mr. Davy also suggested petroleum, and as an astringent, terra Japonica.

Urine, however, seems to be the best thing to render sugar unfit for common use; as its proportion may be fixed so low that there would be no danger of cattle not eating the sugar when mixed with other food. The effect of urine upon horses is well known, as grooms, when they want a horse to have a remarkably fine coat, mix urine with his corn.

Sugar stained with oil might be mixed with chaff; and as chaff is so astringent that only a limited quantity can be given, not only a greater quantity of chaff could be given, but also a greater quantity of sugar than they could otherwise bear. This would be cheaper than fattening with oil-cakes. Treacle is said to be part of the food of the large show-ox, now feeding by Lord Talbot, and which it is supposed will exceed all others. Cattle prefer the sweetest vegetables. The Swedish turnip, which contains 1-4th more sugar than the common sorts, is preferred before them.

Experience has shewn sugar to be not only nutritious, but also salubrious; and its qualities are not affected by time or weather. The American Indians, when they travel, mix maple sugar with an equal quantity of ground Indian corn, and pack the mixture in little baskets. A few spoonfuls of this mixture in half a pint of water afford them a strengthening meal.

The sugar intended for cattle might be mixed with damaged meal. Horses at sea will eat biscuits, and great quantities of damaged meal are made into dog-bread for kennels. The bakers of this might add sugar to the bread; and if there should be any difficulty in getting cattle to eat this sweet bread, it might at first be ground for them.

It would certainly be desirable that farmers should have an option in the articles to be employed, as different local practices may require something of the kind.

Levigated charcoal would not only be expensive, and afford no nutriment to cattle, but it would also probably be prejudicial to the animal economy, and the sugar might be used for the still, as charcoal is used by rectifiers to improve the flavour of coarse spirit. The charcoal could also be separated with great ease from the sugar by solution in water and filtration.

Observations.—The temporary diminution of the produce of the foreign sugar colonies, in consequence of the disturbances at St. Domingo, some years ago occasioned a vast increase of British capital to be employed in the cultivation of sugar for exportation to the continent. But a similar increase of capital poured into the foreign colonies, in consequence of the disturbed state of Europe, has since enabled those colonies to supply the void with their own sugars; and therefore all the sugar that was purposely grown for the foreign market lies on hand, and can only be sold at a losing price. To open therefore new internal markets for sugar, in order that its *price may be kept up,* is the grand object of the West Indian interest.

That sugar is nutritive there can be no doubt, but there could be little hopes of its being able to supplant the several kinds of food used in this country for stall-feeding, unless the duty levied upon it (which, it must be remarked, is the only mode in which the colonies are taxed) was taken off. How this may be effected is amply shewn by Mr. Parkes.

Description of the Apparatus by which the French Experiment on the Decomposition of Potash has been made at the Royal Institution. By Mr. E. Davy.—*Phil. Mag. No.* 127, 128.

The principal part of this apparatus consists of a common gun-barrel, which is bent in a serpentine form, so that, when the same is inserted through two openings in the sides of a blast-furnace, some iron turnings may lie in the depending part of the curve next the butt-end, which part of the barrel is covered with a lute. A small iron tube, containing very dry potash previously ignited, is ground into the butt-end of the barrel. The salt is let to drop gradually upon the ignited iron turnings through a very minute opening left in the small tube; the other end being closed with a stopper. To the muzzle of the gun-barrel is luted a tube of safety with quicksilver or naphtha, as hydrogen is evolved during the whole process.

The tube containing the potash must be cooled by ice until the iron turnings are red-hot; and the part of the barrel destined to receive the sublimed potassium should be kept cool during the whole process. Towards the end a very intense heat should be employed for some minutes, to drive off the last portions of potassium from the iron turnings.

The best results have been obtained from 1 3-4ths parts of potash, dropped upon 2 and an half of iron turnings.

Observations.—As the potassium is obtainable, by this process, with great ease, and in considerable quantities, it is a discovery of practical use; especially as the small quantity of iron with which the potassium is alloyed does not hinder it from being employed to decompose other substances.

On the new Metals.

Mr. A. Coombes, in the Philosophical Journal, No. 93, says, that Mr. Cooke (see No. XV. p. 285) supposes potassium to be a compound of hydrogen, electrical fluid, and potash: and a theory of the same kind has been stated by Dr. Harrington, substituting the word phlogiston for hydrogen. But water is not essential to the production of potassium; and that metal by combustion yields pure, dry, solid potash.

In some remarks on a paper inserted in the same Journal, it is said, seemingly by the editor, that the alkalies were long ago suspected to be metallic oxides. But A. C. observes that this is not true: the alkaline and common earths have long been thought to be dephlogisticated metals, but not potash or soda. In Dr. Beddoes's Contributions no such opinion occurs, but the metals are supposed to be compounds of hydrogen and azote, which, since the metallization of azote, is not improbable.

The editor of the Philosophical Journal remarks on the above, that even in Fourcroy's Chemistry the metallic nature of potash and soda is indirectly implied, under the general name of salifiable bases. And the same opinion is given more decidedly, and stated in direct terms, in Kerr's notes and additions to his translation of Lavoisier's Elements of Chemistry.

In No. 95 of the Philosophical Journal is another letter by A. Coombes, in which he affirms that the passage in Fourcroy's Syst. des Conn. Chim. ii. 196, is undoubtedly equivocal; and that chemist throughout his work never hints at any suspicion of soda, potash, or ammonia being metallic.

The notes of Kerr are not only guesses, but mere guesses from erroneous facts. Tondi and Ruprecht had attempted to shew that magnesia was a metallic oxide; and as in the Turin Memoirs soda was thought to be a modification of magnesia, therefore that alkali was conjectured by Kerr to be metallic.

The French admit Mr. Davy's claims to the discovery. This discovery arose from clear deductions grounded upon a knowledge of the antecedent analogies. In his lectures in 1807, he stated that all bodies whose composition was known, which were attracted by the negative pole, consisted principally of inflammable

matter. And in his lectures in 1801 (rather 1808) he stated, that in looking for inflammable matter in the alkalies, in consequence of the preceding ideas he had not only discovered it, but had also found it to be metallic. Here sagacious conjecture and sound analogy were followed up by experimental research, and ended in a great discovery.

Guesses, except from experimental inquirers, ought not to be tolerated in science.

A controversy of the same kind has been also carried on in the Philosophical Magazine, Nos. 124 and 125, by anonymous writers, under the signatures of O, An Experimenter, and Philalethes Junior, which was continued by others, viz. S. and A. C. (probably A. Coombes), but whose communications were refused admittance.

It would be needless to reiterate the arguments already stated. Let it, therefore, suffice to observe, that O, in Philosophical Magazine, No. 124, thinks it probable that future experiments will demonstrate hydrogen to be the common inflammable principle, and along with oxygen the ultimate constituents of matter. Many facts might, he thinks, be adduced to prove this, and among them the experiments of Braconnot, "notwithstanding the captious objections of an English professor of respectability." Oxygen and hydrogen are said by O to be the only well-characterized elementary substances in nature.

The Experimenter is highly offended at "the indecorous manner" in which O speaks of Mr. Davy, and surprised that the editor should suffer such unworthy criticisms to pollute his Magazine.

Philalethes Junior is equally "surprised that expressions so unwarrantable" should find admission into the Magazine. Mr. Davy's discoveries, he says, "are glorious, for they were not the result of a parcel of guesses, but of a fine train of reasoning, from data of his own; as was most justly observed by Tribunus, in the Times of the 5th of October." This newspaper critic, after a violent tirade in favour of experimental philosophers, and their exemption from the authority of criticism, which can properly judge only of opinions, imagines the Edinburgh reviewers were led to attribute the successes of Mr. Davy to chance, in order "to prevent the excessive admiration inspired by Mr. Davy from exciting visionary speculations in science;" and he farther thinks "it is even possible that their conduct originated in an apprehension that his transcendent success might damp the ardour of other experimenters, and, instead of provoking emulation, inspire despondence."

The editor of the Philosophical Magazine has not only apologized for admitting the letter of O, but also observes, that Mr. Davy's modesty and merit ought to have shielded him from what

Mr. Tilloch calls the wanton attack made upon him by certain northern reviewers.

Observations.—When one writer attacks another for an alleged inaccuracy, it behoves him to avoid, with the greatest care, the falling into the same error. The Experimenter is very severe upon O, for saying that Lavoisier supposed the fixed alkalies to be metallic oxides, and yet he has himself fallen into the vulgar error of considering Columbus as the discoverer of America, although it is now well known that it had been colonized by the Icelanders, and afterwards abandoned some centuries previous to the voyage of that Genoese mariner, as may be seen even by a mere English reader in Forster's Northern Discoveries, or in Macpherson's Annals of Commerce.

Philalethes Junior in his paper observes, that distilled water is proved by Mr. Davy to contain both saline and metallic impregnations, which would afford "much, probably ample food to the seeds sown by Mr. Braconnot." Is it possible that this anonymous writer can suppose that an impregnation which could not be discovered but by the most accurate investigation of the residuum of a large quantity of water, could afford ample food to plants growing in limited quantities of that fluid?

Ever since the rise of the French system of chemistry the muriatic, boracic, and fluoric acids, as also the fixed alkalies and alkaline earths, have been continually referred to the class of oxygenized or burned bodies, on account of their analogy to other acids, or to metallic oxides: and experimenters have frequently endeavoured to demonstrate the truth of this opinion. The metallization of the earths, announced by Tondi and Ruprecht, was proved to be fallacious by Tihawski, Klaproth, and Savaresi. Mr. Davy has, therefore, the merit of being the first that really procured the metals from the alkalies and the earths; but it is evident, from Mr. Davy's own account, that the facts arose spontaneously by progressive steps from investigating the apparent production of muriatic acid by the galvanization of water, as announced by Dr. Pacchioni, of Pisa (see Retrospect, vol. i. p. 181), for the previous discoveries of Mr. Cruikshanks seem to have been forgotten, or at least not followed up.

This supposed formation of muriatic acid was found to be only apparent; but a novel mode of investigation unexpectedly presented itself, which being applied to the bodies, whose composition resisted the ordinary agents employed by chemists, produced the present abundant harvest of facts.

Analysis of Pit Coal. *By* DAVID MUSHETT, *Esq.—Phil. Mag. No.* 126.

IT is surprising that the accounts of pit coal hitherto presented to the public should be so scanty.

Welsh furnace coal from Cyfartha is a deep shining black, of an irregular texture, and rather soft. Its specific gravity is 1.337. It yielded by distillation 91.5 per cent. of dark silvery, very sonorous coak, which left, on burning, 3.482 of grayish red ashes. The specific gravity of the coak was 1.

Alfreton furnace coal is a glossy black, composed of alternate layers of soft coal, and black charry matter, with some thin laminæ of thin coal. Spec. grav. 1.235. It yielded 54.5 per cent. of lighter gray coak, and more cellular than that of the Welsh coal. This coak swam upon water, and left, on burning, 2.044 of light brown ashes.

Butterly furnace coal is a dull, sooty, strong, hard coal, of a sharp and uneven fracture. Spec. grav. 1.264. It yielded 56.17 per cent. of light gray silvery coak, not welded together. The spec. grav. of this coak was 1.1, and it left, on burning, 4.288 of pure white ashes.

Welsh stone coal. Its spec. grav. was 1.368. It yielded 92 per cent. of coak, whose spec. grav. was 1.3934, and left, on burning, 2.3 of grayish brown ashes. The coak of this coal lost 10 per cent. on being exposed for 10 minutes in a heat of 178° Wedg. and became of a more metallic appearance than before.

Welsh slaty stone coal. Its spec. grav. was 1.409. It yielded 90.9 per cent. of coak, which left 6.725 of whitish gray ashes.

Derbyshire cannel coal, found in the same strata as the Alfreton furnace coal. Its spec. grav. was 1.278. It yielded 53 per cent. of coak, which left 4.638 of reddish brown ashes.

Kilkenny stone coal. Its spec. grav. was 1.602. It yielded 95.75 per cent. of coak, whose spec. grav. was 1.6568, and which left 2.873 of clay-brown ashes.

Stone coal found under basalt in Scotland, yielded 83.34 per cent. of coak, which left 13.6 of ashes.

Kilkenny slaty or cannel coal. Its spec. grav. was 1.445. It yielded 87 per cent. of coak, which left 6.525 of ashes.

Cannel coal, from Lismahago, in Scotland, yielded 43.43 per cent. of coak, which left 4 of ashes.

Stone coal, from Boolavooneen, in Ireland. Its spec. grav. was 1.436. It yielded 86.2 per cent. of coak, whose spec. grav. was 1.596, and which left 3.24 of brownish red ashes.

Stone coal, from Corgee, in Ireland. Its spec. grav. was 1.403. It yielded 90.9 per cent. of coak, whose spec. grav. was 1.656, and which left 3.409 of clay-brown ashes.

Stone coal, from Queen's County, Ireland. Spec. grav. same as the last. It yielded 89.7 per cent. of coak, whose spec. grav. was 1.6218, and which left 3.14 of ashes.

Coak from stone coals in general has a greater specific gravity than the raw coal, and it is difficult to distinguish between the two states.

Stone wood, from the Giant's Causeway, in Ireland. Its spec. grav. was 1.15. It yielded 66.63 per cent. of coak, which left 11.933 of ochrey brown ashes.

Well-dried oak yielded 20 per cent. of charcoal, which left 0.5 of deep brown ashes.

Twenty grains of each of the coals and coaks were fused with 100 of oxide of iron, and yielded the following results.

	Iron revived by the raw Coal.	Charcoal left in the Crucible.	Iron revived by the Coak.	Charcoal left in the Crucible.
	gr.	*gr.*	*gr.*	*gr.*
Welsh furnace coal..	40.	2.	34.5	2.75
Alfreton ditto.....	47.25	——	47.	1.5
Butterly ditto.....	44.	——	42.	1.75
Welsh stone coal....	43.25	1.75	39.	2.75
—— slaty ditto....	46.5	3.5	37.5	4.25
Derby cannel ditto..	42.	——	46.5	3.5
Kilkenny stone ditto.	41.75	1.75	38.	1.75
—— slaty ditto.	41.5	1.5	16.	glass
Boolavooneen ditto..	44.5	3.5	18.	ditto
Corgee ditto.....	42.75	3.	27.	ditto
Queen's County ditto	40.75	2.75	20.	ditto
Stone wood.....	45.	——	44.5	——
Oak wood.....	12.5	2.5	48.	2.5

These results will afford abundant matter for speculation to those who are interested, or curious in the affinities of iron or carbone.

Account of a British vegetable Product, that may be substituted for Coffee. By Mr. William Skrimshire, *Junior.—Phil. Journ. No. 96.*

The iris pseudacorus, fleur de luce, or common yellow water flag, grows in great abundance in some marshes, and by the sides of rivers and ditches. The seed-pod, vulgarly called old sows, yields, by threshing, a large quantity of seeds, covered with chesnut-coloured husks; which, on being roasted in the manner of coffee, resemble it in colour and flavour, with something of the saccharine odour of the extract of liquorice, but

nevertheless possessing more of the aroma or peculiar scent of coffee than any other seed.

The fresh root of this plant is a very drastic cathartic, but it loses this quality by drying, and becomes a very powerful astringent, so as, when perfectly dried, to be one of the effectual remedies against a laxity of the bowels. The coffee from the seeds is very wholesome and nutritious, and appears to possess most of the chemical as well as the physical properties of foreign coffee.

Besides the arillus that merely covers the crown of the seed, it is covered with a brown epidermis, that gives it the appearance of very fine shagreen. On roasting these seeds, they first change to a reddish brown, then to a dark brown, and at last become almost black. At this period they appear oily, emit a dense smoke, and acquire the scent of coffee. Although the epidermis is carbonized, it does not easily separate from the seed, but gives it a very dirty appearance; so that they require to be rubbed with a cloth, or shaken in a bag, to free them from the carbonaceous matter, by which means they receive a polish so that they may be handled without staining the fingers.

By over-roasting, the aroma, as in coffee, is destroyed, and the seeds become black.

The roasting of these seeds must be performed slowly, as otherwise the oil, being burned, would communicate a nauseous flavour; and if the seeds are not sufficiently dried they will remain too tough for the mill.

The aroma of this coffee has been preserved in the greatest perfection by roasting the seeds in the husks, which would be the best method of conducting the process if an easy method of separating the roasted seeds from the husks were contrived.

Observations.—Mr. Skrimshire's proposal for making coffee from the fecula of potatoes was noticed in our last Number.

The general use of tea in this country has occasioned our countrymen to be far inferior to their neighbours on the continent in the preparation of coffee, so that the coloured water drank here, under the name of coffee, is as much the object of derision to a foreigner, as their soup-maigre is to us.

The activity with which the West Indian planters have endeavoured of late to extend the use of *their* coffee, will probably increase the consumption of the article in general, and then the enterprising spirit of Britons will soon discover many indigenous seeds that will make as good coffee as the original berry. On the continent the original berry is used only by the higher classes; various roots and seeds, as the roots of succory or wild endive, barley, &c. are most usually employed; the want of an oil, in some of these substances, being compensated by the addition of butter or sweet-oil during the operation of roasting.

AGRICULTURE.

Memoir on the Irish Fiorin Grass, a Variety of the Agrostis Stolonifera. By WILLIAM RICHARDSON, *D. D. late Fellow of Trinity College, Dublin.—Comm. Board of Agric. Vol. VI. Part I.*

THE grass which is the subject of this memoir is peculiar to the kingdom of Ireland; and abounding particularly in the little peninsula of Portrush, on the northern coast, which is the residence of Dr. Richardson, its high verdure and uncommonly thick sward does not fail to attract the notice of his visitors. Among the sojourners at Portrush was Mr. Davy, whose inquisitive mind soon noticed the luxuriance of the soil, and at the same time inquired into the cause: his host was pleased with the opportunity of displaying his acquaintance with Mr. Davy, and replied to his inquiries by transmitting the present memoir.

The writer states, that though the Irish had lavished encomiums on the fiorin grass, and though he had himself printed, for private use, a short essay on the indigenous grasses of the country, yet that he long remained unacquainted with this particular species, or more properly *variety*; he at length, however, met with a person who knew it well, and undertook to point it out, and they proceeded to a contiguous bog which furnished abundance. He proceeded to make some experiments on this curious grass, some of which are here related, and prove that it was well worthy of attention, and likely to support the high character it had obtained.

In the month of March he raised several sods of the fiorin grass, which was at that season easily distinguishable by its long white strings, and tied the strings of one sod, when planted in the garden, about a stick two feet long; and though these were dead to all appearance, yet, when the weather became warm, they began to bud at the joints, and the buds soon became green shoots, producing pannicles at their extremities, so that the bundle round the stick resembled a handful of dead hay mixed with verdant stalks, or a growing sheaf of oats in a wet harvest. Finding the principle of vegetation to exist in the stalks, though dead to appearance, he endeavoured to propagate from them, and in the beginning of May sowed a small rich plot in his garden with fiorin strings, by spreading them on the surface, and covering them with mould, which soon vegetated and produced a thick sole capable of being mown in September; and observing the new strings to manifest an inclination to transgress the limits of the bed, he cleared a way for them, and in a short time they advanced twenty-eight inches into the adjacent plot, and formed one of the thickest soles he had ever known, being impenetrable

to weeds or any other kind of grass. He also sowed another plot in a *hortus irriguus*, with strings, in the same manner, and they soon vegetated there; and when the shoots were considerably advanced, he ran water over them, and they throve far more luxuriantly than those in the preceding experiment, in consequence of the irrigation; and as shoots soon became extremely long, they were tied up to sticks, like peas, and in a short time reached five feet high, when they seemed to stop, swell, and harden, still, however, producing new shoots from the joints, which hung down, and made a singular appearance. He also propagated this grass by roots, and found it succeed equally well. As the summer advanced, some of it was transplanted and regularly watered, and though the season was unfavourable and the plants far advanced in vegetation, still they came rapidly forward, projecting new shoots in every direction, and, with the assistance of a little good compost, formed a complete sward in two months. These experiments were all made in rich dry ground, but Dr. Richardson also tried soils of a very different quality.

He dug up in December a coarse, sour, ungenial piece of ground, and inverted the sods, and slightly raked the surface in the spring, not daring to disturb it more: in May he planted more of this with sets from the morass, and sowed the rest with strings; both came up well, and were sprinkled over with compost, and in August they began to shoot in every direction, and formed a compact sward by the middle of October; and as some sour moor-ground, scarcely above the level of the stagnant water, occurred in forming the last bed, this was also planted with the strings, merely to hide the naked appearance, and a small part of it with roots of the *festuca fluitans*, and the whole was then irrigated; the *fiorin* shoots soon projected in all directions, and left no space for those of the festuca, and the whole became an excellent uniform sward. These two experiments are conceived to be of great importance, as they prove that cold sour bottoms may, with no very great expense, be changed into the most valuable pasture or meadow.

All these trials were made in the county of Tyrone; an accidental one at Portrush gave a similar result. Some nettle-roots were dug up in the middle of a grass-plot, and the place was sown with grass-seeds in order to restore the verdure; but, on examining the place some weeks afterwards, the contiguous fiorin was found to have run its shoots across the naked place in every direction.

It being conceived that the great powers of vegetation possessed by the fiorin grass are fully ascertained by the preceding experiments, the writer proceeds to inquire into the quality of the food it yields for cattle. The *fiorin* hay he has heard much commended, and is disposed to believe every thing favourable, though he cannot speak from his own knowledge; but as to the excel-

lence of the grazing produced by it, he can give full proof, and relates that he formed his first attachment for Portrush Hill, when he was a college boy, five and forty years ago, from the great superiority of the pasture, which superiority is equally conspicuous at the present day, and is owing entirely to the fiorin grass with which it abounds; and this superiority is proved by a detail of comparative experiments for twenty-three years.

In answer to the question, what soil is most favourable to the culture of this valuable grass? it is stated that it seems to thrive equally well on the most opposite soils; for it can hardly be doubted to be an aquatic, since it grows in the wettest bogs and morasses, sending its shoots into the water, and the buds issuing from the joints rising strong to the surface; and when these creepers reach the opposite side of the drain or trunk, proceeding on with increased luxuriance: and though the festuca fluitans may be considered as the most decided aquatic of the grass tribe, yet where it is intermixed with the fiorin, it has been found impossible to transplant the festuca where the fiorin does not equally succeed. And it is proved, by several of the experiments in this memoir, that the fiorin thrives in a rich dry soil; and that it takes possession of a thin dry soil is demonstrated in all the steeps facing the northern coast of Ireland, and particularly about the Giant's Causeway, where the steeps are covered with it, and where the roots force their way through the crevices of the rocks, and even into the intervals between the Causeway pillars.

The most important fact relative to this grass Dr. Richardson conceives to be, that it grows spontaneously very far up on the bleakest and wettest mountains of Ireland; he has observed it on the highest ridges in the county of Derry, thriving as far up as the road reached. And, indeed, the great difference of the soils, in which this grass seemed to flourish with equal vigour, induced him to think there might be two varieties of it, each adapted to its own soil; and in order to ascertain this, he brought sets and strings from the driest situations, and planted them in the wettest, but all came forward with the same luxuriance; and though the pannicles seem to indicate two varieties, he has not been able to discover them by trying the seeds separately. Yet this curious property of the *fiorin grass* to thrive in such opposite soils, has led him to look for something similar in the kindred grasses, and with this view he is trying experiments, both under irrigation and on rich and dry soils, with the *festuca fluitans* and *alopecurus geniculatus*.

It is not doubted but that the *fiorin* is an indigenous Irish grass, since every inquiry brings information of its being known and admired, though no instance has been found of its being cultivated or propagated by itself; but it is said to be known and cultivated in America, for in 1806 an Irish gentleman, resident in that country, sent over two packets of grass-seeds to the Dublin

Society, some of which were obtained by this writer, and one of them, he says, promises to be the fiorin grass, or a variety of the species, its seedling plants being unusually slow of growth and singularly delicate. It also appears to him not to be known in England, since he can trace no mention of it by English agricultural writers, yet he thinks it highly probable that it is the same grass, which has been so much admired in the celebrated Orcheston meadow near Salisbury, which was first noticed by Ray, who says it was twenty-four feet long, and has been since visited and examined by so many botanists without agreeing among themselves on its name or species, and without making any known attempt to cultivate or propagate so valuable a grass. Most botanists, whose opinions are detailed in the memoir, agree, that it is a species of *agrostis*, and Mr. Sole has determined it to be the *agrostis stolonifera*; and the many circumstances in the diversified accounts of the Orcheston grass, leave in the mind of the writer little reason to doubt that it is identically the same with the fiorin grass of Ireland, or at least a variety extremely similar to it, and that the high character this meadow has obtained arises from the excellent qualities of this valuable but hitherto neglected grass.

The reason why this grass, which obviously thrives in all soils and situations, is rarely noticed, except in the very worst, is conceived to be probably that in rich and kindly grounds its competitors, the common grasses and weeds, contend with it to advantage; but these, being unable to withstand the severity of the northern blasts, yield undisturbed possession to the fiorin on bleak and shallow steeps; and in swamps the fiorin has to contend with rush, flag, and sometimes reed, and yet it struggles with these on a tolerably equal footing, for the grassy part of the sward, in such situations in Ireland, is found composed mostly of fiorin; but the pasture or hay produced from these bottoms is so adulterated by the mixture of the coarse aquatics, that the excellence of the *fiorin* part of the compound is not discovered, nor the grass itself suspected to be valuable.

Dr. Richardson goes on to observe, that though the experiments he has hitherto made on the fiorin grass have been limited to the garden, yet, as an advance towards carrying theory into practice, he requests such gentlemen as are fond of agricultural pursuits, to co-operate in making experiments on this promising grass, and to try whether it cannot be brought, by reasonable exertion, to occupy somewhat larger spots of ground, and with what prospect of success its cultivation may be extended. With this view he divides the grounds of Ireland into three different classes;—1. Common arable, pasture, and meadow grounds;—2. Coarse, wet, sour bottoms;—3. Moory and heathy mountains.

As to land of the first kind, he conceives the established excellence of the little grazing field at Portrush affords sufficient encouragement to try the *fiorin* as pasture grass on good and dry

grounds, while the great crops there and at Orcheston prove its value as a hay-grass, though he admits it ripens rather too late, unless forwarded by irrigation: he planted some roots in a barley field, at six inches distance every way, and they all succeeded, though they had to contend with many weeds; and he tried another experiment, with equal or greater success, after a crop of early potatoes, and has no doubt but this will be found the most convenient mode of propagating this valuable grass, for he has little hope of succeeding by sowing its seeds, on account of the great delicacy and slow growth of the young tendril.

The second description of ground, the coarse wet bottoms, are held to be of much greater importance in the present point of view, as these are but little productive, and comparatively of small value. He considers his experiments to have sufficiently established, that such grounds are capable of being completely clothed with a thick sole of fiorin grass in a short time; but, on account of the great toughness and viscidity of such grounds, he fears the expense of breaking them up would be too great for the practical farmer; and as an economical mode, recommends two crops of potatoes with ridge and furrow of equal breadth, which will leave it in an excellent state for *fiorin* grass, and will perhaps repay the labour; but in such bottoms as are too wet, or too liable to be flooded, to venture a crop of potatoes on them, he advises to dig parallel trenches or drains the depth of a spade, about five inches deep and five feet asunder, and lay the sods in heaps to form a compost for the next year; or, in case they should abound with flags and rushes, to fill the trenches with compost made rich with ashes, and plant the *fiorin* roots in them; and in this way he thinks success may be confidently expected: it is however added, that all these wet grounds should be effectually drained, to enable the fiorin grass to contend with its aquatic enemies upon vantage-ground.

The third division, that of moors and heathy mountains, includes a description of ground well known in the north of Ireland, which is called cut-out moss; and it is asserted to be hardly credible with what facility the very worst and wettest of these abandoned spots may be completely clothed with *fiorin* grass, the only difficulty being to protect them from cattle; for manure is unnecessary in such very wet situations, and little labour is required, as the ground is mostly level; and fiorin roots shoot here so rapidly, that they may be planted eighteen inches asunder, and the only care necessary is to exterminate such rushes as may casually arise. The immense extent to which improvement may be carried on this kind of soil is particularly descanted on. It is noticed, that if we look to the habits of the *fiorin* grass, we shall have little doubt but that it was endowed with them by nature to clothe with verdure such soft and yielding swamps, and while it produces abundant food for cattle, at the same time enables the

surface to sustain them on the matted net-work which it forms: it is recommended to agriculturists to avail themselves of these hints of nature, since scarcely any ground is too wet or too soft for this kind of grass to change into a firm pasturage; and a few trials are noticed, and many arguments both of a public and private nature adduced, to recommend the practice; some speculative opinions are likewise offered, which it is unnecessary to notice.

It is contended that the expense of introducing fiorin grass into mountainous tracts is easily ascertained, and cannot be enormous, nor will there be any difficulty in procuring plants, should the scheme once succeed, as by the strings they may be multiplied to any extent; the writer has gathered 140 strings from one root, which averaged six joints to each string, and on wet ground the moss and peat will itself answer all the purposes of manure; and by burning it, immense quantities of ashes may be obtained on the spot. And in reply to objections it is insisted, in conclusion, "that the speculation itself cannot fairly be called wild, which requires no other postulate, than that a *certain grass, when fostered by the hand of man, encouraged by manure, and protected from its enemies, will thrive in the same soil and climate, where it thrives spontaneously without any of these aids.*"

Observations.—This ingenious and well-written memoir introduces the English agriculturist to a species of grass which has not been hitherto cultivated, and indeed scarcely known in this country, but which seems to be most admirably adapted for reclaiming the moss and peat bogs, which are found to such an immense extent in the northern and western parts of our island. The simple and unexpensive mode of cultivation peculiar to the fiorin grass, must recommend its adoption to the British farmer as soon as it is known, for such low wet situations, as well as for very elevated spots, where no indigenous grasses can be made to flourish. As the most expensive operation in reclaiming a morass is the draining off the stagnant water, the gradual introduction of this grass will much facilitate the measure, as it will supersede the necessity of draining the whole at one time, and render the bog able to bear labouring cattle without having recourse to artificial means of extending the surface on which they bear. Though the experience of the writer gives satisfactory information of the value of this grass as food for large cattle, its usefulness as hay and sheep-feed rests only on probable conjecture; and it is desirable that it should be ascertained by experiment. And in truth we think Dr. Richardson acts with becoming caution in hesitating to recommend the introduction of *Fiorin* to the *practical* farmer, till the more opulent agriculturist has ascertained its merits beyond a doubt. This diffidence of the writer ought not, however, to be construed into any doubts which he may entertain of the ultimate success of this grass, when cultivated on an extensive scale, but

is the result of that natural modesty which always accompanies real literature, such as all, who know him, know Dr. Richardson to possess.

Remarks on Plantations of Ash Trees, and on the Advantages derived from them. By DAVID DAY, *Esq. of West Hill, near Rochester, Kent.—Trans. Soc. Arts, Vol. XXV.*

THIS gentleman had, as early as 1783, communicated to the Society a detailed account of experiments in planting ash trees, and in this paper he points out the subsequent management of them. He has now declined all business but that of raising ash trees for his own amusement, and for improvement of the landed interest, and is so certain of success attending plantations of this kind, that he professes his willingness to advance as much as thirty thousand pounds, on landed security, and on having the execution of such improvements under his own inspection, either jointly or on the owner's account. Where there are at present wild or uncultivated woods, he recommends to grub up the old wood, and either put the land into tillage, or plant it properly with fresh wood, which would produce four times as much both in timber and underwood. He states, that he has made from the underwood of some of his own plantations 94*l.* per acre, at only ten years growth, and has plantations of which the underwood alone will produce 150*l.* per acre, besides the expense of falling. He observes, that little knowledge of conducting improvements can be expected except from executive men, and asserts, from experience, that his plan will yield an ample profit to any person who engages in it with attention, since when the plantations are once put in order, they require but little to be done afterwards. And in order to shew the reality of the profit arising from these plantations, an account is given of the expenses incurred, and money received, since 1779, on about 46 acres, the total profit of which, according to these statements, amounts to 1525*l.* 5*s.*

The mode of sowing the seed and managing the plants is then described. He carefully procures from good, straight, well-proportioned ash trees, the keys or pods containing the seed between Christmas and the middle of February; and as soon as the ash keys are collected, and a hole prepared in the ground about three or four feet deep, he lays a bed of sand, a few inches deep, at the bottom of the hole, upon which he places a layer of ash keys about two inches thick, and covers them with about the same thickness of sand, to preserve them from heating; after which he proceeds with alternate layers of the keys and sand, till the hole is full. They are suffered to remain in this state till the beginning of March in the following year, when they should be taken out for sowing, and will be found in a swelled state, ready

for vegetation: drills should then be made in land properly prepared in the same manner as for sowing peas, and the keys laid regularly in them and covered over with mould; and in about six weeks the young plants will appear above ground, and should be kept quite clear from weeds: in the March of the following year they should be planted out in rows a foot wide, and placed three or four inches asunder in the row; in which state they are to remain for two or three years, when they will be in a proper condition to plant out where they are to remain. The ground designed for the plantation should be a good loamy soil, not too wet or stiff, and be previously well ploughed the preceding autumn, and at the time of sowing opened into drills about two feet apart, and the plants placed in alternate drills at two feet distances. The drills should be ten or twelve inches deep, and the planter should set each plant upright in the drill, and draw the earth to it with his foot, and tread it well in; and whenever a plant with a larger root than common occurs, a hole should be made within the drill a little deeper than usual, to receive the plant. Disposed in this manner, a statute acre will contain five thousand four hundred plants. The intermediate rows may be either kept open as drains, or planted with beans or potatoes.

In the second year the young plants should be cut down with a bill close to the ground, when the produce will serve for fire-wood, and pay the expense of cutting; and from the stubs thus left in the ground, the regular crops of ash are produced, and are fit for falling every ten years. The usual season is between Christmas and March, and Mr. Day sorts his poles into three different qualities for hop-poles, besides stakes and fire-wood; and they obtain a considerable price. And when the plants are left uncut for twelve or fourteen years, the produce is fit for other purposes, such as wood proper for wheelwrights and coopers, besides hop-poles.

The value of plants, which have been two years in the nursery-beds, and are ready for planting out, is stated to be from six to ten shillings the hundred, according to their quality.

Observations.—It has become fashionable with stewards and agents to depreciate ash plantations, under the pretence that this species of wood materially deteriorates the soil, and is comparatively of small value as timber, and besides destroys the herbage which grows under its shade. These opinions, however, do not seem to be well founded, for the shade of ash is not more destructive to vegetation than that of other trees; and though the timber is certainly inferior to the hard-grained woods, for building purposes, yet it is far preferable to elm, being less liable to warp, if well seasoned before it be used, and is always a valuable wood to the wheelwright and the cooper. It must also be evident to every one concerned with the sale of underwood, that those lots are

most eagerly purchased, which contain the greatest quantity of ash poles, on account of the many uses to which this species of underwood may be applied. And Mr. Day is entitled to the thanks of the landed interest for the perspicuous manner in which he has detailed the best mode of sowing and managing ash plantations; and as he states the number of plants raised by him to be about 725,000, his instructions must necessarily be formed on the basis of knowledge and experience.

On the Chinese Method of propagating Fruit-trees by Abscission. By Dr. James Howison.—*Trans. Soc. Arts, Vol. XXV.*

It is stated that the Chinese do not raise fruit-trees from seeds or grafts, as is customary in Europe, but in the following method: they select a tree which they wish to propagate, and fix upon a branch which will disfigure it the least by the removal; and round this, as near as conveniently may be to its junction with the trunk, they wind a rope made of straw besmeared with cow-dung, until a ball is formed five or six times the diameter of the branch. This is intended as a bed into which young roots may shoot; and immediately under the ball the bark is divided down to the wood for nearly two thirds of the circumference of the branch: a cocoa-nut shell, or small pot, is then hung over the ball with a hole in the bottom, so small that water put therein will only fall in drops, by which means the rope is constantly kept moist; a circumstance necessary for the ready admission of the young roots, and for the supply of nourishment for the branch. When the vessel has been supplied with water for three weeks, one third of the remaining bark is cut, and the former incision carried deeper into the branch, as by this time some roots have struck into the rope, and assist in giving support. After a similar interval, the operation is again repeated, and in about two months from the commencement of the process, the roots are generally seen intersecting each other on the surface of the ball; which indicates that they are sufficiently advanced to admit of the separation of the branch from the tree; and this is best done by sawing it off at the incision, taking care that the rope, which must have become nearly rotten, is not shaken off by the operation; and then the branch is planted as a young tree.

It is conceived that a longer period would be necessary to succeed with this operation in Europe, because vegetation is so much slower here than in India, where Dr. Howison made his experiments; but he thinks that an additional month would be adequate to make up for the deficiency of climate.

The advantages of this method are stated to be, that a farther growth of three or four years is sufficient, when the branches are of any considerable size, to bring them to their full bearing state;

whereas eight or ten years would be otherwise necessary: this he saw proved from experiment at Prince of Wales's Island. The writer's experience does not allow him to speak of the success with which this method might be applied to forest trees, but he little doubts of its succeeding, and the adoption of it is recommended at all events in multiplying such plants, natives of warmer climates, whose seeds do not come to maturity in this country. He has besides frequently remarked that such branches of fruit-trees as were under the operation of abscission at the time of bearing, were more laden with fruit than the rest of the tree, which is attributed to a plethora or fulness, occasioned by the communication between the branches and the trunk being cut off by the division of the bark, and has observed that the roots from a branch under this operation were longer in shooting into the ball of straw, when the tree was in leaf, than at another time, on which account he recommends the spring as the best season for making experiments.

Observations.—This mode of propagating trees, which prevails in many parts of Eastern Asia, is deserving the notice of our horticulturists at home; and from the prevailing inclination to pursue that branch of science, we have no doubt of being soon able to communicate experiments of this mode of propagation in our own country.

Account of a new Method of rearing Poultry to Advantage. By Mrs. Hannah D'Oyley, *of Sion Hill, near Northallerton.—Trans. Soc. Arts, Vol. XXV.*

This method, the economy and facility of which she has proved by experience, is communicated by this lady, because she thinks it may be of essential benefit to the community. She keeps a large stock of poultry, which are regularly fed in a morning upon steamed potatoes chopped small, and at noon upon barley. In the poultry-yard is a small building, like a pigeon-cote, for the hens to lay in, with a frame with nets to slide before each hole: the building is kept dry, light, and well ventilated, and the floor is once in a week strewed with fresh ashes. When she wishes to procure chickens, she sets many hens together, confining each to her respective nest by drawing the sliding net before the hole, and they are let out daily for air, and exercise, and food; and as soon as they hatch, the chickens are taken away, and a second lot of eggs allowed them to sit again, by which means they produce as numerous a brood as before. She puts the chickens into long wicker cages placed against a hot wall at the back of the kitchen fire, and within them has artificial mothers for the chickens to run under, which are made of boards about

ten inches wide and fifteen inches long, supported by two legs in the front, four inches in height, and by a board at the back two inches high; the roof and back are lined with lamb-skins, dressed with the wool upon them, and the roof is thickly perforated with holes; they have no bottom, but have a flannel curtain in front and at the ends, for the chickens to run under, which they do apparently by instinct; the cage is kept dry and clean, with either sand or moss, and is a proper size for fifty or sixty new-hatched chickens. When they are a week old, they are carried, with their artificial mother, to a grass-plat, in fine weather, and the mother is kept warm by placing a long, narrow, tin vessel at the back, filled with hot water, which will keep its heat for three hours at a time; and towards the evening they are removed back again to the hot wall. When about three weeks old, they are put into a small room appropriated to that purpose, which is fitted up with frames similar to the artificial mother placed round the floor, and with perches conveniently arranged for them to roost upon. When Mrs. D'Oyley first attempted to rear poultry in this way, she lost several, owing to the roofs of the mothers not being sufficiently ventilated, and experienced many losses from improper food, till she thought of getting coarse barley-meal, and steaming it till it became soft, with which; and minced potatoes, they are fed alternately, and frequently excited to eat by pellets of dough, which are thrown to them rolled up. Upon this food they are said to grow surprisingly, and become soon fit for the table or market; and a confidence is expressed that the mode might be pursued near populous towns with immense profit; and it is asserted that a young person of twelve or fourteen years old might bring up some thousands in a season; for hens may be set four times in a year, and be made to hatch two broods at each setting. The proper heat of the wall is stated to be 80° of Fahrenheit, and the troughs for the food are placed withoutside the cages, from which, to the artificial mother, a small quantity should be littered, to point out the way to the trough. The Society voted Mrs. D'Oyley their silver medal, and she returned the compliment by a present of chickens to the officers resident in the Adelphi.

Observations.—To such as rear poultry for the market, and devote their whole time to the pursuit, Mrs. D'Oyley's method will need no recommendation, for it will be found a source of considerable profit, but it requires such constant care and unremitted attendance, that none but an old maid would attempt it as an amusement.

Observations concerning Limestone and Limestone Gravel. By A. B.—*Farmer's Magazine, No.* 36.

As the sentiments expressed in this paper are not the result of experience, but rest only on theory and conjecture, it may be sufficient to remark that the writer, living some years since in a part of the country where limestone and limestone-gravel abound, and observing that, when peat was used as fuel, the limestones were broken small, on account of the less intensity of the heat, and knowing also that the more intimately any substance is divided, the more powerfully it will be acted upon by a chemical agent, it occurred to him that many poor tenants in the Highlands might supply themselves with a good manure at a cheap rate, by burning the limestone-gravel in kilns built of sods, or such coarse peats as were unfit for burning limestone, and carting out the whole, kiln and all, as a manure. In order to prove that limestone-gravel may be calcined in this way, a reference is made to the Chemical Essays of Bishop Watson.

On the Culture of Hemp and Flax, particularly by the labouring Poor. By R. R. *of Lidlington, Bedfordshire.—Agricultural Magazine, No.* 16.

It is recommended in this paper, as a laudable pursuit to Agricultural Societies, to encourage the growth of hemp and flax by cottagers who possess a piece of garden-ground, by offering a premium to those who shall raise and prepare for spinning, and spin into cloth, the greatest number of plants of flax grown in their several gardens, or produce the greatest number of yards of cloth made from the same; for it is conceived that by this means a considerable quantity of flax would be raised in the kingdom, and the poor cottagers provided with cheap, durable, and good linen, for the use of their families, besides their wives and children being more usefully and more healthfully employed in spinning, than in making lace, and other sedentary employments, which but too frequently lead to consumption. And the writer conceives that if this plan were acted upon and encouraged by premiums properly adapted, there would arise a competition for superiority among the poor in every village, and many hours, now devoted to idleness, would be usefully and cheerfully occupied in attending to their gardens, while at the same time the health of their families would be considerably amended by having a more frequent change of clean linen, and a sort of pride would

manifest itself in having it said that their linen was of their own growth and manufacture.

Observations.—As far as our recommendation can add weight to the opinions of this modest and sensible writer, we strenuously advise a trial of the plan on the same principles, and for the same reasons, as have induced him to bring the subject to public notice.

Economy in planting Onions. By Mr. John Saunders, *of Stroud, Glocestershire.—Agricultural Magazine, No.* 17.

Mr. Saunders announces a successful experiment on the bulb of the common onion: he notices the usual practice of planting the onion whole, when it is put into the ground to produce seed, and censures the *extravagance* of the mode; "whereas, by cutting the onion right down with a sharp knife, and squaring or dividing off the outer parts, so as to leave only the centre part to plant, a person *may retain more than two-thirds of the bulb to be eaten.*" The centre of the bulb was committed to the earth, and the seed was produced in perfection. Mr. Saunders exulted in having conducted an experiment *successfully*, and communicated the result to the Agricultural Magazine!!

Observations.—That Mr. Saunders should exult in *success* was undoubtedly to be expected, after the vain projects of hay-tea, sunflower-seed, &c. had foiled his dearest hopes. His contributions to this publication are below both criticism and contempt.

On the Cultivation of Hemp. By Mr. J. Hutchinson.—*Annals of Agriculture, No.* 269.

This gentleman having cultivated land in France, as well as in England, and having induced the late Mr. Pitt and Sir Brook Watson to bring a bill into Parliament to promote the cultivation of hemp here, the Editor of the Annals applied to him for information respecting the sowing hemp as the first crop on a bog, whether this was done with success in France, and whether paring and burning were necessary. Mr. Hutchinson replied, that he had not witnessed many instances of sowing hemp for the first time on boggy lands in France, because it was very generally cultivated, and there was no inducement to increase the breadth of ground employed; that it was generally sown in small pieces, the persons who cultivated it mostly manufacturing it themselves

in their own families; and as peat was the common fuel of the peasantry of France, that paring and burning, for the sole purpose of cultivation, was never resorted to. Generally speaking, however, he considers it highly advantageous to sow hemp on fresh land, as that will dispense with the use of dung for at least two crops, and the quantity produced is abundant; and he has seen hemp cultivated successfully on moor-land, but he did not see it brought into cultivation.

Observations.—The information contained in this paper, though unimportant in itself, confirms the opinion of some speculative writers as to the probability of success in sowing hemp on new broke-up land.

Description of a Balance Level, useful for laying out Land for Irrigation, for Roads, and other Purposes. By Mr. Richard Drew, *of Great Ormond Street.—Trans. Soc. Arts, Vol. XXV.*

The level is mounted on a ball and socket joint, and consists of two tubes of tin made to slide on a short tube placed in the middle, and these two tubes are furnished with eye-glasses. The balance level hangs by a sort of staple fixed upright at the top part of the tube, and the level is ascertained by the balance hanging free, and a slit corresponding with two horse-hairs drawn across the middle of the eye-glasses. The adjustment is the same as that of all other instruments on a ball and socket, with the addition of a rack worked by a key to obtain greater nicety in the level; and any variation between levelling backwards and forwards is directed to be adjusted by taking the medium. The instrument is said to have been satisfactorily used on several estates in Devonshire, where the inventor has been employed to drain and irrigate meadow-land; and he made several others for persons employed in draining and irrigation in the west of England. The Society of Arts voted ten guineas to the inventor.

Observations.—It is not easy to convey an accurate description of this balance level, without the assistance of a plate, an advantage which accompanies the original paper: but it is merely levelling by a bit of tin with a slit in it hanging from a staple instead of by a spirit level, and in our opinion not only less scientifically, but also less certainly.

On the Culture of Spring Wheat; and on the Use of Tar and Tincture of Opium in the Diseases of Cattle. By SPENCER COCHRANE, *Esq. of Muirfield House, near Haddington.*—*Trans. Soc. Arts, Vol. XXV.*

THIS gentleman has had much experience in raising spring wheat, and some of his communications to the Society on that subject may be found in the 20th volume of their Transactions. As the result of that experience he recommends, in the event of land having been fallowed and sufficiently cleaned before winter, and wet weather setting in so as to prevent wheat being sown at the usual time, that wheat be sown in the spring on the winter furrow, and that the land be not ploughed again at the time of sowing; for the winter frost meliorates the soil, and kills the annual weeds; and he has remarked that by following this mode the land is much less troubled with them, the weeds being a general objection to spring wheat. Should this kind of wheat follow turnips, he thinks the ground should be ploughed as soon as possible, if the soil is of a wet nature, to correct the injury sustained, and by the poaching of carts and waggons; and from the middle of February to the 10th of March is stated to be the proper time for sowing wheat in the spring, provided the land is sufficiently dry, when the seed, having been previously pickled, should be put in on the first furrow either by drill or broad-cast, and the land should be kept dry by opening the furrows.

Having imprudently allowed his cows to eat clover when wet, they were in consequence seized with violent swellings: he was advised to put an egg-shell full of tar immediately down the creature's throat, and he found that it had the effect of allaying the swelling in a few minutes, and this not in one only, but in repeated experiments.

The best remedy for recovering horses from the gripes, a disorder which frequently proves fatal, he states to be a table-spoonful of the tincture of opium or liquid laudanum; and if the first dose, given in some liquid, does not allay the violent pain and swelling, he administers a second spoonful, which he has, in all cases, found to have the desired effect, and generally in a very short time; and if the horse be very hot and feverish, he orders him to be bled plentifully, and administers an ounce or more of nitre with the laudanum, keeping the horse warm, and letting him be well rubbed round the belly. He has also administered laudanum to sheep with equal success, and he considers sixty drops a proper dose.

The paper concludes with a recipe for a syrup prepared from

poppies, for the cure of colds and coughs in the human species, which we pass over, as foreign to the subject.

Observations.—The remedies suggested by Mr. Cochrane for the swelling of cattle after eating wet clover, and for the gripes in horses and other cattle, are as good as any which have been hitherto made known, and may be resorted to with safety and with every prospect of success. Tincture of opium, frequently repeated in moderate doses, is one of the most powerful anti-putrescents that can be applied.—The remarks on spring wheat evince experience, and the time of sowing pointed out is especially deserving of recollection.

On Plantations. By the Earl of Fife.—*Trans. Soc. Arts, &c. Vol. XXV.*

The noble Earl, after observing that his plantations in the counties of Banff, Aberdeen, and Murray, extend over a space of more than thirteen thousand acres, states, that on the highest grounds in Duff-house Park, even where exposed to the sea by cutting down firs and other trees, where they interfere with each other, the oaks and other close-grained timber-trees rise vigorous and healthy, and will be very valuable, the oaks in particular. The silver fir and larch is also said to attain to a considerable size; and two silver firs and a larch, which were cut down to make room for other trees, were sawed up into boards; the boards of the larch made very handsome tables, and those of the fir remarkably white and finely polished floors. These trees were about forty years old.

The high wind of Christmas 1806 having blown down a large silver fir which had been planted by the Earl 51 years before, it was found to measure 9 feet 7 inches in girth at the ground, and at 7 feet high, where the limbs branched off, about a foot less: the tree contained also a vast quantity of wood in it, which was ordered to be manufactured for different purposes. Pineasters of the same growth are much larger in size, but their wood is not so fine.

In raising oaks the Earl does not recommend planting acorns, but rather procuring young plants at two or three years old. Larch is thought to thrive best when the seedlings are planted out in moors; and Scotch firs may be bought cheaper than they can be raised, though such are seldom found to be so well rooted.

Observations.—The experience and success of this patriotic Nobleman, who has paid the debt of nature since he made this

communication to the Society, surely cannot fail to induce other landed proprietors of the uncultivated parts of Scotland to improve their estates by extensive plantations. The larch and the silver fir will succeed on the most barren, and in the most exposed situations, and are more generally calculated for the northern parts of Britain than the oak and other hard-grained woods; yet as the value of this description of timber is every day increasing, it would be advisable to intermix some of these in all new plantations, that trees of inferior value may be removed to make room for them if they thrive; and the risk, in case of failure, would not in this way be of material importance, as every plantation requires thinning in some way or other.

Additional Communication from Mr. CRAMP, *of Lewes, respecting the Produce of his Cow; addressed to the Earl of Chichester.—Communications to the Board of Agriculture, Vol. VI. Pt. I.*

THIS paper is a continuation of one noticed in the preceding volume, p. 403, and states, that this cow produced, from the 19th April 1806, to the 27th February 1807, 450lb. of butter, which was sold for 32*l.* 9*s.* 6*d.* and 3687 quarts of skim milk, which, at one penny per quart, was worth 15*l.* 17*s.* 3*d.* Her calf was sold for 30*s.* and four loads of dung were made during the season, which was worth 3*l.*: so that the whole produce was 52*l.* 6*s.* 9*d.*; and the expense of maintaining her during the time was 21*l.* 10*s.* 8*d.*—leaving a profit of 30*l.* 16*s.* 1*d.*

Observations.—On a comparison of this produce with that of the preceding year, noticed in our former volume, it may be safely inferred that the produce of the second year from a cow kept in the house is considerably less than the produce of the first year. It would be desirable if Mr. Cramp would annually continue his account of the produce of this animal.

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